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The Universal Law

The General Theory of Physics and Cosmology

Volume II

- concise version -

NEW EUROPEAN ACADEMY PRESS
(NEA PRESS)

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ISBN 3-00-004078-1

New European Academy Press (NEA Press)
München, Sofia

Printed in Germany

For Annette

CONTENT

THE NEW PHYSICAL AND MATHEMATICAL AXIOMATICS OF THE UNIVERSAL LAW

ABSTRACT

In 1995, I discovered the **Universal Law** of nature (the Law); I showed that all physical laws and their applications can be derived from this one law within mathematical formalism, and explained it epistemologically. This has led to the development of a unified theory of physics and cosmology, which is an axiomatization (axiomatics) of physics and mathematics. Thus physics is applied mathematics. The major results of this theory are: all terms in physics can be axiomatically derived from the primary term - **energy = space-time** (primary axiom). Energy (space-time) is *closed*, *infinite*, *continuous*, *inhomogeneous* (*discrete*), and *constant*; it is in a state of permanent energy exchange. The continuum (the set of all numbers) is equivalent to the primary term. The new axiomatics can be empirically verified. Thus the validity of mathematics as challenged by Gödel's theorem can be proven in the real word (proof of existence). This eliminates the continuum hypothesis and the foundation crisis of mathematics. The Universal Law describes space-time in terms of mathematics. The **universal equation** is $E = E_A f$, where E is *energy exchange*, E_A is a specific constant amount (quantum) of exchanged energy, called „*action potential*", and $f = E/E_A$ is called „*absolute time*". It is a dimensionless quotient. The Universal Law is a „law of energy". Energy (space-time) is the only real thing. All physical quantities such as mass, charge, force, and momentum are abstract subsets of space-time that are defined within mathematics (objects of thought). They are dimensionless numbers that belong to the continuum. Since they contain space-time as an element (U-subsets), they can be derived in an axiomatic manner from the primary term. For instance, mass is a synonym for an energy

(space-time) relationship and charge is a synonym for area, that is, the SI unit 1 coulomb is equivalent to 1 m^2. This leads to the unification of physics and cosmology on the basis of mathematical formalism. This new **physical and mathematical axiomatics** also integrates gravitation with the other forces. It will be outlined in the Mathematical Appendix that follows this propaedeutics.

INTRODUCTION

Since Einstein, it has been the dream of many physicists to discover the „universal field equation“ and derive all known laws from same. Contrary to this endeavour, modern physics sustains that nature is regulated by many different physical laws. They are products of various disciplines, such as classical mechanics, thermodynamics, wave theory, electromagnetism, quantum mechanics, theory of relativity, QED, QCD, etc. We encounter various laws, the most prominent of which are: Newton's axioms of classical mechanics, his law on gravity, Kepler's laws, the first and second law of thermodynamics, Boltzmann's law, laws of radiation (Wien's displacement law, Stefan-Boltzmann's law), classical wave equation, various laws of electricity and magnetism, which can be regarded as precursors of Maxwell's four equations of electromagnetism, Schrödinger wave equation of quantum mechanics, etc. Unfortunately, physicists have failed to prove why nature needs so many laws, and how it coordinates them. The new axiomatic approach in physics proves that these different laws are equivalent mathematical presentations of one single law of nature. This proof forms the basis of the new unified theory of physics and cosmology.

Although the necessity of axiomatizing physics on the basis of mathematical formalism was postulated a long time ago (1), this target has not been achieved yet. The discovery of the Universal Law of nature has led to the establishment of a general theory of physics and cosmology, which is an axiomatization of physics and mathematics (2-5). It confirms all the mathematical and experimental results obtained in physics. At the same time it reveals that some basic interpretations of these results are essentially wrong from an epistemological point of view. Such mistaken conclusions have precluded the unification of physics. The major results of the new physical axiomatics can be summarized as follows:

1. Energy (space-time) has only two dimensions (constituents), space and absolute time**.** They are canonically conjugated reciprocal magnitudes that can be expressed as numerical relationships. All physical quantities as measured by the SI system can be derived from these two quantities. This means that the SI system is redundant and should be abolished in theoretical physics.

2. There is no vacuum. There are only photons (photon level) perceived as space (extent). The photon level has the same properties as matter, for instance it can be assessed in terms of mass and charge. Two new fundamental constants have been derived: mass $m_p = 0.737\times10^{-50}$ kg and charge $q_p = 1.29669\times10^{-39}$ m^2 of the basic photon (h).

3. All physical constants can be derived from these two constants by applying the universal equation. This is a basic proof that the physical world is a unity - it is equivalent to the continuum n (see Table 1).

4. A novel method has been developed, which enables many new physical constants to be derived and experimentally verified. All natural constants are dimensionless numbers - they are independent of the choice of the surrogate reference system, e.g. SI system.

5. Charge is a synonym for area: 1 *coulomb* = 1 *square meter*.

6. The basic terms - time, temperature, and relativistic mass - are dimensionless numbers (quotients), the definition of which is mathematics. They are physical circumlocutions of the probability set ($0\leq P(A)\leq1$) as introduced by Kolmogoroff in his theory of probabilities. The probability set is equivalent to the primary term $P(A) = n$ = *space-time* = *energy*.

7. The standard model of cosmology (the hot big bang hypothesis) must be refuted - the universe does not expand. Instead, there is an incessant exchange of energy (and mass) between photons and matter. This exchange is responsible for gravitation, as has been confirmed by the discovery of many new cosmological constants. These constants build a numerical input-output model of the universe. This model is equivalent to the continuum.

8. The standard model of physics must be refuted in its reductional attempt to explain nature on the basis of a few elementary particles. At the same time the new theory confirms all the mathematical results obtained in QED, QCD, and GUT.

9. Although the various mathematical expressions of the second law of thermodynamics are derivations of the universal equation, the notion of growing entropy in the universe as stated by this law must be rejected.

The relevant mathematical proofs of these results are given in the Mathematical Appendix, which takes due account of the basis of modern physics and cosmology. The new physical axiomatics follows the principle of inner consistency and lack of contradictions. Therefore, it would be sufficient to reject only one of the aforementioned results to renounce the existence of the Law.

METHODOLOGY

A methodological analysis of the epistemological foundations of modern physics reveals that the basic terms of this science are not defined. Although all physical laws are laws of energy interactions or can be derived from the concept of energy, physics does not know what energy is in real terms (6). The same holds true for classical space known as Euclidean space (7), relativistic space-time known as Minkowski's world (8), charge, and mass (9), and Hilbert's space of quantum mechanics (10). The only method of describing the physical world is mathematics - all laws and their applications are mathematical equations. This proves that the physical world is of a mathematical nature. However, physics does not give any explanation for this fact in terms of knowledge. The agnosticism of physics concerning its primary terms is propagated in all subsequent concepts and vitiates the edifice of this empirical discipline.

Like physics, mathematics cannot define its primary terms, such as point, straight line, plane (area) in geometry (10,11), continuum in the theory of sets (12), and number in algebra (13). This has precluded the axiomatization of mathematics by finite procedures (14) as proven by Gödel (15). This has led to the **foundation crisis** of mathematics as embodied in the continuum hypothesis (16) and Russell's antinomy (17). Mathematics is a hermeneutic discipline without any real object of study;

it deals with „objects of thought“ (Dedekind). Gödel has proved that any axiomatic system of mathematics (18) contains primary statements, which have their source in human consciousness and cannot be determined in a finite way by secondary definitions that are also products of the mind (15). Thus consciousness is part of mathematics and subsequently of any empirical discipline based on mathematics (19). However, consciousness is excluded from physics as an explanatory principle - it is substituted by empiricism.

Based on this methodological analysis, I have come to the conclusion that it is possible to establish a complete axiomatics of present physical and mathematical knowledge based on a single primary term, if we depart from the principles of mathematical formalism. This approach furnishes the missing „existence proof“ in the real physical world and solves the foundation crisis of mathematics that has persisted since 1931, following the publication of Gödel's first theorem.

The primary term of the new axiomatics is a product of our consciousness; more precisely, it can be equated with our consciousness and can be arbitrarily called „energy“, „space-time“, „cosmos“, „universe“, „the whole“, „continuum“, or „being“ („be aware of being“). From an epistemological point of view, the choice of the name is of no importance. This primary (ultimate) knowledge is defined as the „**principle of last equivalence**“ (primary axiom). It is the furthest boundary of any human knowledge - for ever.

The principle of last equivalence is the common axiomatic origin of physics and mathematics. According to it, the idea of the continuum in the theory of sets, which is the basis of modern mathematics, is equivalent to the primary term. The same holds true for the probability set in Kolmo-goroff's theory of probabilities (20). According to Gödel's theorem (15), the equivalence between the primary term, the continuum of numbers, and the probability set cannot be proven (or rejected) on mathematical grounds. It is *a priori* axiomatic knowledge. However, it can be verified by all experimental facts (proof of existence). That is the objective of the new unified theory of physics and cosmology based on this principle (2,3,21).

We take into consideration the fact that all physical phenomena (real objects) are adequately expressed by abstract mathematical symbols and equations, which are objects of thought, and prove that all mathematical equations are concrete applications of the principle of last equivalence for the parts (see below). Thus any mathematical equation is a subset of

the primary term and contains it as an element (17). According to Russell, such sets are called **U-sets** - a U-set is the total set of all sets that contain themselves as an element. The same holds true for all the physical quantities that appear in such equations - they are U-subsets of the primary term. As all physical quantities are defined within mathematical formalism, they are abstract concepts with no real meaning (objects of thought). The only real thing is the primary term, that is, energy or space-time.

This novel epistemological approach is based on a single term. It reveals that physics is mathematics applied to the physical world. Therefore, it can be axiomatized according to the deductive principle of inner consistency and lack of contradictions. This approach explains the trend towards mathematisation (neologism) in all sciences and leads to the development of a **General Theory of Natural Sciences** (21-26).

The validity of the new physical axiomatics can be proven in the real world because the proof of existence is furnished by the principle of last equivalence. This is the main difference between the new axiomatics and pure mathematics. While the former discipline operates with real objects, the latter deals with objects of thought. The objective of the new axiomatics is to prove that all abstract mathematical concepts and symbols, such as numbers and signs of relation, adequately express the primary physical term, „energy = space-time“. In other words, they are evoked in the mind by its very nature.

BASIC AXIOMS

The Primary Axiom

The primary axiom of relation is „energy is equivalent to space-time: energy = space-time“. All further names and symbols used for the primary term are equivalents. This includes the term „consciousness“. This axiom is called the „**principle of last equivalence**“ (PLE):

$$\begin{aligned} &\textit{Energy} = \textit{Space-time} = \textit{Consciousness} = \textit{Universe} = \textit{Cosmos} = \\ &= \textit{Nature} = \textit{Continuum} = \textit{Probability Set} = \textit{The Whole} = \\ &= \textit{Mathematical Symbols} \end{aligned} \qquad \text{(A-1)}$$

The primary term is a U-set - it is the total set of all sets that contain themselves as an element. All physical terms and quantities that adequately reflect the phenomenology of space-time are mathematical U-subsets of the primary term, that is, they are objects of thought that contain the whole as an element. Any physical idea that excludes the primary term as an element is an N-set; it has no correlate in the real world and should be excluded from physics as a wrong idea. Such ideas are vacuum, closed system, etc. For instance, vacuum is considered the set that contains all energetic particles: the void contains something. The N-set is essentially a paradox or antinomy. The primary term can only be assessed in logical categories. As mathematics is the prolongation of logic with abstract symbols, both are hermeneutic disciplines of correct thinking. It is believed that they have no external object of study. According to PLE, their external object of study is space-time (proof of existence). Hence the mathematical character of the physical world - all natural laws are mathematical equations.

Properties of Space-Time

The properties of space-time are: **closed character**, **infiniteness**, **continuousness**, **inhomogeneity** (**discreteness**), and **constancy**. They are interrelated U-sets and thus equivalent to the primary term. U-sets cannot be separated in real terms, but only in an abstract way in the mind. These properties are manifested by all U-subsets of space-time. The conservation of energy (1st law of thermodynamics) confirms the closed character of space-time. The quantization of energy in photons ($E = hf$) and particles (Bohr's model, Schrödinger wave equation) confirms the inhomogeneity of space-time and the constancy of the quanta, for instance h, and the existence of natural constants. The equivalence between energy and space-time proves the continuousness of the physical world and excludes the idea of the void (vacuum) as an N-set - the extent is space-time, that is, energy.

Space-time can be subdivided into infinite levels and systems. The U-set of equivalent constant amounts of energy, called „**systems**", is defined as a „**level**". For instance, all protons have the same energy (at rest) and form the proton level. As we do not know how many protons there are in the universe, we define the proton level as infinite. The discreteness of space-time is infinite in real and abstract terms. It is not possible

to distinguish between the abstract infinity of numbers as objects of thought (mathematics) and the real infinity of levels and systems of space-time. Hence the equivalence between consciousness and the primary term - consciousness is reflected space-time. All levels and systems are open - they exchange energy (space-time). We say: „they interact". The openness of the U-subsets of space-time is an aspect of its infinity. However, space-time itself is closed.

Symbolic Expression of the Primary Term

„Energy exchange" and „energy interaction" are synonyms for the primary term. Space-time is in a permanent state of energy exchange:

$$\textit{primary term} = \textit{energy exchange} =$$

$$= \textit{space-time exchange} = E \qquad \text{(A-2)}$$

According to PLE, the arbitrary symbol „*E*" of the primary term is an object of thought. Therefore, it can be substituted by any other mathematical symbol, such as:

$$E = \infty = 1 = E/E = 1/1 = 1/\infty = \infty/1 = \infty/\infty = \text{etc.} \qquad \text{(A-3)}$$

It is important to observe that this equivalence cannot be rejected on mathematical grounds because it concerns the proof of existence. According to Gödel's theorem, this proof cannot be given by means of mathematics. The equivalence of the symbols in (A-3) is beyond the reach of mathematical argumentation. At the same time it is the epistemological (philosophical) origin of mathematics. For instance, we can substitute the primary term in (A-3) with any quotient of infinite mathematical complexity, which can be a product of differential, integral, or exponential calculus $1 = \infty/\infty$, where „∞" stands for mathematical complexity.

Basic U-Subsets of Energy Exchange

The energy exchange between levels is arbitrarily called „**vertical energy exchange**" and that between systems „**horizontal energy exchange**".

E is at once vertical and horizontal (U-sets). The elementary event of energy exchange is called „**action potential**“ and is symbolized with E_A. As all systems and levels are U-subsets, the definition of the elementary event is an arbitrary decision of the mind. We call this „degree of mathematical freedom“. Thus any system or level can be defined as E_A. Any arbitrarily defined E_A has a correlate in the real world (U-set). All physical events or phenomena that are objects of study in physics can be defined as „action potentials“ and expressed as E_A. Thus the term “action potential“ is the total U-set of all discrete events of energy exchange. For instance, the basic system of a level, say, an electron, is called an „elementary action potential“ and can be expressed with E_A. The level is the total set of all action potentials pertaining to it, e.g. an electron level. The systems of this level are sets consisting of E_A, e.g. electron orbits; at the same time they are subsets of the electron level. E_A is a specific mean constant amount of energy for each level or system, defined in an abstract way within mathematics.

The quotient of energy exchange and action potential is defined as “**absolute time**“ or simply “**time**“: $f = E/E_A$**.** The quantity time is an abstract U-subset (object of thought) of space-time, which is an integral part of mathematical formalism. It is a dimensionless number, a quotient, belonging to the continuum. This term is not identical with the quantity „conventional time, t“ as used in physics today. The definition of the latter quantity requires the definition of the SI unit „second“ and its method of measurement (see below). Thus the quantity „conventional time“ is a secondary U-subset of the primary category „time“, which is directly derived from the primary term in an axiomatic, *a priori* manner. Conventional time is a concrete quantity of time. We shall show that many physical quantities which are erroneously regarded as distinct, real quantities appear to be particular mathematical parameters of time. The most outstanding are: *temperature* and *magnetic field* (see Mathematical Appendix).

The Universal Law is a Mathematical Equation

The primary term can be expressed as a mathematical equation:

$$\boldsymbol{E = E_A f} \qquad \text{(A-4)}$$

We have called it the „**universal equation**“ (UE). This mathematical expression considers all the properties of space-time. The proof is cogent. All conventional laws are mathematical equations and thus U-subsets of space-time - they contain (A-4) as an element. We shall prove that they are mathematical derivations of UE, that is, they are objects of thought and have no real existence outside mathematics. Thus there is only one law, called the „**Universal Law**“, which is expressed by the above equation. It assesses the primary term mathematically and is equivalent to it. According to PLE, equation (A-4) can be expressed by any other symbol, such as:

$$E = E_A\, f = 1 = \infty = n = 1/n^n = n^n/1 = n \times 1/n =$$

$$= \sum\infty \times \sum 1/\infty = \infty/1 \times 1/\infty = etc. \qquad \text{(A-5)},$$

where the primary number „1“ is the universal mathematical symbol of equivalence with respect to the primary term; this number can also be used for any subset thereof, e.g. as the „certain event“ in statistics. In (A-5) n is the continuum, ∞ is infinity, $1/\infty$ is the infinitely small number, and $\infty/1 = \infty$ is the infinitely great number. The last two terms define the continuum: $1/n \to 0$, when $n \to \infty$. In the theory of sets, „zero“ and „infinity“ are called limits of the continuum. They are abstract subsets (objects of thought) of the primary term. It is important to observe that all these abstract symbols can be substituted by any other symbol or word which is of the same mathematical character. They will inevitably assess the properties of space-time, for example, its infinity due to the closed character. As space-time is of mathematical character, all words and symbols used for the continuum reflect its closed nature. For instance, instead of saying in mathematics „the continuum is infinite“, we can say „the infinity is continuous“. This follows from the principle of last equivalence, which is the common origin of mathematics and physics. The existence of such tautologies determines the limit of any human knowledge for ever and proves the closed character of space-time.

From this we conclude that the continuum is an equivalent and adequate term of space-time. As Kolmogoroff's probability set $0 \le P(A) \le 1$ is obtained from the continuum by mathematical transformation according to PLE: $1/n \to 0 = P(A) \ge 0$, and $n \to \infty = P(A) \le 1$ (according to PLE, $1 = \infty$), this basic term of statistics is another equivalent, abstract presentation of space-time. We call this set the „physical probability set“ and

express it with the symbol SP(A), where „S“ stands for „structure“, so that we can distinguish it from Kolmogoroff's abstract term. This new symbol allows the epistemological discrimination between the theory of probabilities as a hermeneutic discipline and statistics as mathematics applied to the real physical world, e.g. in thermodynamics, QED, QCD, etc. From this we can write PLE as follows:

$$Energy = Space\text{-}time = n = 0 \leq SP(A) \leq 1 = SP(A) \qquad \text{(A-6)}$$

The equations from (A-1) to (A-6) are iterations of the primary term according to PLE - they are mathematical tautologies or pleonasms thereof. This is a basic proof for the closed character of space-time. Any mathematical equation is an iteration of the last equivalence for the parts (U-subsets of space-time). For instance, the universal equation (A-4) can be expressed as a rule of three $a = b/c$ or a function $y = ax$. The latter is the origin of any other function, such as:

$$y/(a^n x^n ... + ... a^{n-m} x^{n-m}) = 1, \text{ where } m = 1,2,3 ... n \qquad \text{(A-7)}$$

or

$$(a^n x^n ... + ... a^{n-m} x^{n-m})/y = E_x / E_r = E_x / 1 = E_A f \qquad \text{(A-8)},$$

where

$$E_x = a^n x^n ... + ... a^{n-m} x^{n-m} = ax = E_A f = E_A = cons., \text{ when } f = 1 \qquad \text{(A-9)}$$

This proves that mathematics is a system of mathematical iterations of the universal equation, while the latter is the „mathematical envelope“ with which the nature of space-time is formally wrapped. With respect to tradition in physics, we call this equation the „Universal Law“, or just the „Law“. This is justified, as all known physical laws and equations can be derived from this Law (see Mathematical Appendix).

Quantities of Space-time and Their Method of Definition and Measurement

All the physical quantities with which nature is described are abstract U-subsets of space-time. Mathematics is the only method of definition and measurement of such quantities, that is, they have no real meaning outside mathematics (objects of thought). Physical quantities are built according to the „principle of circular argument“ (PCA). This is the only op-

erational principle of mathematics and physics. In fact, it is the only cognitive principle of our mathematical consciousness. PCA consists of two dialectical aspects: 1) the building of equivalencies, e.g. as SI units - all meter rules are the same the world over; 2) the building of comparisons, e.g. measurements with SI units. The PCA is an application of PLE for the parts - it departs from the whole to explain the parts. This principle is thus a U-subset of PLE. The building of any mathematical equation with a view to assessing U-subsets of the primary term is based on PCA. This means that all known physical laws, expressing relationships between various physical quantities, abide by PCA and PLE. They contain the primary term as an element.

The principle of definition of physical quantities used in physics today is „circulus viciosus“, that is, any quantity is defined through other quantities, e.g. mass through acceleration, charge through current, etc. One part is explained by other parts, while the primary term is neglected. Physics does not know the nature of space-time. This has led to a profound agnosticism with regard to the meaning of these quantities. This conclusion will be proven in detail in the Mathematical Appendix.

Dimensions and Units of Space-Time

Physics consists of two parts: theoretical and empirical. The theoretical part consists of definitions of physical quantities; the empirical part consists of their measurement (experiments) by building relationships (comparisons). The method of definition of quantities is at the same time their method of measurement - both methods are applications of PCA. There is no exception to this equivalence between theory and empiricism. Within mathematics the primary event is the *a priori* definition of quantities as objects of thought. Empiricism is of secondary importance - it is a tautology of the Law. This fact proves that mathematical consciousness is an adequate reflection of the physical world. This is the epistemological background of the new axiomatics. Modern physics, on the contrary, has failed to give an explanation of its terminology from an epistemological point of view and has, instead, resorted to pure empiricism as a source of knowledge.

Any quantity is expressed in units. Each unit stands for a dimension, and each dimension corresponds to a quantity. However, there are quantities that have more than one dimension, e.g. force is expres-

sed by the dimensions mass, length, and conventional time, with the units [kgms^{-2}]. The definition of a quantity cannot be distinguished from the definition of its unit(s) and dimension(s). Each definition of a unit is based on a real reference system of space-time. For instance, both *meter* for space and *second* for conventional time are defined with respect to the photon level according to PCA: 1 meter is equivalent to the distance travelled by light (visible photons) during 1/299,792.458 second; 1 second is defined by the frequency of photons $f = c/wavelength$ emitted by a caesium atom. As $c = f\,\lambda$, both definitions are circular. The SI units, „1 second" for the dimension (quantity) „conventional time t " and „1 meter" for the dimension (quantity) „distance" are thus surrogates of real space-time quantities (relationships). They are obtained through measurements for real systems and can hence be eliminated within mathematics. Indeed, from an epistemological point of view the SI units should be eliminated because they obscure our physical outlook (*Weltanschauung*). If we compare the wavelengths λ and frequencies $f = 1/t$ of two photons by defining one of the photons as a reference system, we obtain dimensionless quotients for the two dimensions, space (distance) $\lambda_x / \lambda_r = \mathrm{SP(A)} = n$ and time $f = 1/t = f_x / f_r = \mathrm{SP(A)} = n$. The same holds true for any other real distance and time. The terms „meter" and „second" are non-mathematical surrogates substituting the reference frequency f and wavelength λ of a real photon system, which has been arbitrarily selected as the initial system of reference. It can be substituted by any other real system of space-time.

It is generally acknowledged that there are six basic quantities and units - *space* [m], *conventional time* $t = 1/f$ [s], *mass* [kg], *temperature* [K], *amount of substance* called *mole* [mol], and *current* [A]. As charge is actually introduced through current in a circular manner, this quantity is not basic. All other quantities can be derived from these six quantities and their units within mathematics. We shall prove that the last four basic quantities and their units can be derived from the first two dimensions, space and time, within mathematics. This means that space-time has only two dimensions or constituents, space and time *f*: hence „space-time" for the primary term. Thus all quantities can be expressed in terms of space and time (see Table 2). As all physical laws assess relationships between various quantities, this also holds true for these laws. This allows the establishment of a new simple mathematical symbolism that can be axiomatically introduced from the primary term.

Motion is the only Manifestation of Space-Time

Consciousness assesses energy exchange as motion (displacement). Motion is the only manifestation of energy exchange or space-time. The universal physical quantity of motion in physics is *velocity* v. From v one can obtain further quantities of motion within mathematics, for instance acceleration *a*. As velocity is an abstract mathematical quantity too, it can be substituted by any of these quantities without affecting the validity of the present axiomatics. We have chosen velocity as the universal quantity of motion for practical and historical reasons. Velocity is defined within mathematics as a quotient of the two basic quantities, space and conventional time, according to PCA $v = s/t$. Within 3*d*-Euclidean space, distance is given as [1*d-space*], area as [2*d-space*], and volume as [3*d-space*]. The method of definition of these abstract quantities is *geometry*. We shall use these symbols in the new axiomatics for any spatial presentation [*n-d-space*], where *n* means any number of dimensions and is equivalent to the continuum. This symbol includes any geometric presentation, such as multidimensional spaces in topology (e.g. in string theories) or fractal spaces in chaos theory.

The new dimensionless quantity *time* $f = E/E_A$ is defined in an *a priori* mathematical manner as a quotient of the primary term and its universal event - the „action potential“. The latter term is also defined in an *a priori* manner as the total set of all events or phenomena in the real world. The two terms, time *f* and action potential E_A, are the two most important subsets that establish the unity of space-time because they completely assess its properties in a mathematical way. For this reason we use only these three symbols in the universal equation $E = E_A f$. Within mathematics, the number of symbols standing for different quantities of space-time can be augmented *ad infinitum*. We call this “degree of mathematical freedom“ - like space-time, the number of physical quantities is theoretically infinite. Hence the intrinsic complexity of physics, which is applied mathematics. This mathematical complexity has hindered the perception of the Law. This is the greatest fallacy of modern physical theory.

When the surrogate SI system is employed, the abstract quantity time can be assessed by the actual parameters, frequency *f* or reciprocal conventional time $1/t$, within mathematics according to PCA: $f = E/E_A = 1/t = f$. Both quantities are U-subsets of time. In this way we conclusively eliminate the term „conventional time“ from physical theory and substitute it with the term „time“ *f*. This is also the reason

why we use the symbol „ *f* “, which is traditionally employed for frequency, although we could just as well introduce any other symbol for time. It is important to observe that frequency or its reciprocal „conventional time“ are not the only actual quantities of time. For instance, we can establish within the new axiomatics that *temperature* and *magnetic field* are further specific quantities of time. This negates the exclusive character of conventional time. For practical purposes, we can still use *t* in terms of seconds or any other unit of time by employing conversion factors. Within mathematics, velocity can be expressed as:

$$\mathsf{v} = [1d\text{-}space] \times f = [1d\text{-}space] \times [absolute\ \ time] =$$

$$= [1d\text{-}space\text{-}time] \qquad \text{(A-10)}$$

The product of one-dimensional space [1*d-space*] and time *f* results in an abstract mathematical quantity, called „one-dimensional space-time“. It is a U-subset of the primary term. The method of definition is geometry (space) and algebra (time), that is, mathematics. Space and time are “constituents“ of space-time. This is an axiomatic definition derived from the primary term. According to PLE, we can express the primary term as follows:

$$E = E_A\, f = \mathsf{v} = [1d\text{-}space\text{-}time] = \mathsf{v}^n = [n\text{-}d\text{-}space\text{-}time] =$$

$$= constant = 1 \qquad \text{(A-11)}$$

Reciprocity of Space and Time

Equation (A-11) proves that the space-time of any system or level is constant because it is a U-subset and manifests the constancy of space-time as an element. For example, the speed of light *c* is a constant one-dimensional space-time of the photon level $c = [1d\text{-}space\text{-}time]$. This axiomatic conclusion is confirmed by all the facts - it is irrevocable proof that the new axiomatics adequately assesses the physical world (empirical validation):

$$\mathsf{v} = [1d\text{-}space\text{-}time] = [1d\text{-}space]\, f = \infty \times 1/\infty =$$

$$= constant = 1 \qquad \text{(A-12)}$$

We conclude from (A-12) that space and time are *canonically conjugated*, *reciprocal quantities* that cannot be separated in real terms (U-sets), but only in an abstract way in mathematics, that is, in the mind. The infinitely great number ∞ and the infinitely small number 1/∞, defined as the limits of the continuum, are thus mathematical symbols which intuitively reflect the reciprocity of real space and time. As space and time cannot be separated in real terms, they form the unity of space-time. Thus space-time contains at once the infinite small and the infinite great. The reciprocity of space and time is without exception - as a fundamental property of space-time, it is manifested by each subset thereof. This is a basic axiomatic conclusion of the new theory that is central to an understanding of the Law. We can write:

$$\text{when } [n\text{-}d\text{-}space] \rightarrow \infty, \text{ then } f \rightarrow 1/\infty \text{ and vice versa} \qquad \text{(A-13)}$$

or

$$E = E_A\, f \approx f = 1/[space] \qquad \text{(A-14)}$$

> **Axiom of reciprocity**: Space-time (energy) is proportional to time and inversely proportional to space. Time is inversely proportional to space and vice versa.

This basic axiomatic conclusion is confirmed by all physical phenomena: the greatest energy is found in the smallest space of the atoms (e.g. strong forces of hadrons and quarks, black holes, etc.) and the smallest energy is found in the greatest volume (e.g. in gravitational objects). There is no exception to this rule. This is a fundamental proof that physics can be axiomatized from a single term.

Mathematical Presentation of the Reciprocity of Space and Time

Space-time is the only real entity. Because of this, the only thing we can do in physics is to assess the actual space-time of the systems or levels. According to PCA, the space-time E_1 of any system can only be assessed in a circular comparison with the space-time of a reference system E_2. This is a consequence of the closed character of space-time. Due to the reciprocity of space and time, the universal equation can be presented as a **rule of three** (RT):

$$E_1/E_2 = f_1/f_2 = [1d\text{-}space]_2 \,/\, [1d\text{-}space]_1 = \mathrm{SP(A)} = K_{1,2} \quad \text{(A-15)}$$

Equation (A-15) proves that all we can do in physics is to compare the space, time, or space-time of one system with that of another. The quantities which are defined in this way are dimensionless quotients, whereas every comparison with a unit reference system $n/1 = n$ is a number belonging to the continuum. This comparison is a real energy interaction. Therefore, any measurement in an experiment is an energy interaction. The dimensionless coefficient $K_{1,2}$ assesses the energy exchange between any pair of systems or levels. It is called the „**absolute constant**" of energy exchange. As all systems are open U-sets, energy exchange always occurs in both directions: in this case, $K_{1,2} = 1/K_{2,1}$. Such constants belong to the continuum or the probability set, that is, to the primary term. By eliminating the surrogate SI system, we prove that all known natural constants are absolute constants. They are constant relationships of space, time, or space-time quantities of real systems, which are obtained within mathematics by employing the universal equation (see Table 1).

Photon Space-Time is the Universal Reference Frame

According to PCA, the universal real reference frame of the new axiomatics is the space-time of the photon level as assessed by the constant speed of light:

$$c = [1d\text{-}space\text{-}time]_p = c^n = [n\text{-}d\text{-}space\text{-}time]_p =$$

$$= constant = 1 \quad \text{(A-16)}$$

The same reference frame is used in classical mechanics as G, in electromagnetism as $c^2 = 1/\mu_0\varepsilon_0$, and in the theory of relativity as Lorentz transformations (see Mathematical Appendix). Theoretically, it can be substituted by any other reference frame (degree of mathematical freedom). We have selected photon space-time as the universal reference frame with respect to traditional physics. This allows a simple transformation of conventional formulae into the new **space-time symbolism**.

The New Space-Time Symbolism

In the above explanations, we have already introduced the symbols of the new integrated physical and mathematical axiomatics, with which all traditional physical quantities (see Table 2) and laws (see Mathematical Appendix) can be presented in terms of space-time:

E	-	Space-time = energy = primary term
E_A	-	Action potential = elementary event of energy exchange: $E = E_A = cons.$, when $f = 1$
f	-	(Absolute) time, $f = E/E_A$
[*n-d-space*]	-	Space in terms of geometry = extent
SP(A)	-	Any physical quantity of space-time as a probability (dimensionless quotient) belonging to $0 \leq SP(A) \leq 1$, where $0 \leq SP(A) \leq 1 = n$. In particular, this symbol is reserved for mass m and charge Q (see below)
$E = E_A\, f =$ [*n-d-space*] $f =$		
$=$ SP(A)[*n-d-space-time*] $=$		
$= n = 1$	-	Universal equation of the primary term according to PLE and PCA. SP(A) stands for the space-time of any system or level (U-subset) that can be obtained as a relationship (probability or number) to a reference system of space-time.

Any science is a categorical system of the mind. When the categories are U-sets, that is, when they are derived from the primary term by PCA, the system can be axiomatized. All axiomatic systems are thus „transitive“ - they are equivalent presentations of space-time. This is called the „com-

mutative law“ of the new axiomatics - it is an iteration of PLE. For instance, geometry can be presented as algebra and vice versa. The new axiomatics is transitive to mathematics: any traditional mathematical expression of space-time in terms of a physical law, a quantity, or a relationship thereof can be expressed in the new space-time symbolism without affecting the final numerical result. Due to the significant simplification of the new symbolism and its clear epistemological background, many new natural constants, which have hitherto evaded the attention of physicists, have been derived for the first time. These constants can be experimentally verified. This is convincing experimental proof that physical empiricism is a tautology of the Universal Law in respect of the particular experimental condition.

The new axiomatics acknowledges the creative potential of mathematical thinking. It is not a particular categorical system, but the universal method of creating infinite categorical systems that abide by the formalistic principle of inner consistency and absence of contradictions. This leads to the unification of science under: one principle = one term.

Mass is an Abstract Mathematical Quantity of the Mind

The quantity mass does not exist. It is an object of thought that is defined within mathematics. In mechanics, mass is defined as „the intrinsic property of an object that measures its resistance to acceleration“ (9). This is a tautological definition of Newton’s 2nd law $F = ma$, where acceleration $a = \mathsf{v}/t = \mathsf{v}f = [1d\text{-}space\text{-}time]\, f$ is already an abstract U-subset of space-time as inherent within mathematics. One abstract subset of space-time is defined in terms of another. All traditional definitions of physical quantities display this vicious character. For this reason, physics cannot explain its terms, such as mass or charge, in terms of knowledge (epistemological agnosticism). This vicious circle is substituted in the new axiomatics by PCA as a U-subset of PLE - we depart from the primary term (the whole) to explain the parts, which are mathematical quantities of space-time. Their relationships are presented conventionally as mathematical equations and defined as „physical laws“. As all mathematical equations are U-subsets of PLE, all known physical laws are U-subsets of the Universal Law, and this law assesses the properties of the primary term mathematically (A-11).

The method of definition of mass is mathematics. It is also the method of its measurement. The real reference system is a standard object preserved at the International Bureau of Weights in Sèvres, France. Its gravitational energy E_x on the earth is called „1 kg“. The measurement of masses, that is, weights, is based on Newton‘s 2nd law (definition) and can be axiomatically derived from the primary term within mathematics:

$$\frac{m_1}{m_R} = \frac{m_1[\mathrm{kg}]}{1[\mathrm{kg}]} = m_1 = \frac{F_1 g}{F_R g} = \frac{F_1}{F_R} = \frac{F_1 s}{F_R s} =$$

$$= \frac{E_1[\mathrm{J}]}{E_R[\mathrm{J}]} = \frac{E_1}{1} = K_{1,R} = \mathrm{SP(A)} \qquad \text{(A-17)}$$

From (A-17) we conclude that „mass“ is a mathematical „**space-time (energy) relationship**“ that is established by PCA. The same is true for „charge“ - it is an „**area relationship**“ defined within geometry (see Mathematical Appendix).

Basic Axioms of Application

Space-time is energy exchange. As it consists of infinite, open U-subsets (levels, systems), it cannot be assessed in a finite, deterministic way. However, any infinite quantity of U-sets forms a set that contains the subsets as an element - the common element being space-time. According to PCA, which is the only operational principle of mathematics and physics, any assessment of space-time needs a reference system. Therefore, any actual space-time exchange can be assessed as an interaction between at least two entities (systems, levels, or action potentials). This knowledge leads to the following fundamental axiom:

> The action potential of a level or system E_{A1} is completely exchanged (transformed) into the action potential E_{A2} of another level or system and vice versa. This is called the „**axiom of conservation of action potentials**“ (axiom of CAP or simply CAP):
>
> $$E_{A1} = E_{A2} \qquad \text{(A-18)}$$

All conventional statements on the conservation of energy (closed character of the primary term) in physics, such as the conservation of momentum, mass, charge, number of baryons, etc., are incorporated in CAP and hence eliminated as distinct laws. This axiom leads to another basic axiom, called the „**axiom of reducibility**“ (AR):

> Any energy exchange in space-time can be regarded as an interaction between two entities (systems, levels, or action potentials), which are U-sets and may contain infinite levels and systems. Any energy interaction results in a new entity, the space-time of which is the product of the space-time of the two interacting entities.

$$E = E_1 \times E_2 = E_1\, E_2 \qquad \text{(A-19)}$$

Both axioms describe the nature of the primary term - they are mathematical variations on the reciprocity of space and time. These two axioms are of great practical importance. As most physical laws are defined for closed systems, they can be defined by CAP. Thus the idea of closed systems, being an N-set, can be eliminated - all systems are open. The AR is the „hidden definition“ (Poincaré) behind all physical laws, which appear to be intuitively correct perceptions of the Law within human mathematical consciousness. The two axioms, CAP and AR, are applications of PLE for the parts. This insight effects a great simplification in our understanding of present-day physics.

Applications of AR and CAP in Physics

AR can be applied to the space-time of any system or a quantity thereof. Consider an object at rest with the mass m = SP(A). When this object moves in space-time, e.g. in a free fall, it acquires additional space-time that can be assessed by the one-dimensional quantity of space-time - the velocity v = [1*d-space-time*]. According to AR, we can regard the mass m, which is a quantity of the space-time of the object at rest E_r, as a distinct entity $E_r = m$ and the space-time of its displacement E_k, which is assessed by the velocity, as another distinct entity $E_k = \mathsf{v}$. In this case, the velocity is a quantity of the gravitation of the earth, which we regard as the second interacting system. The quantities and symbols used for the

space-time of the interacting systems are arbitrarily selected and can be replaced by any other quantity or symbol without affecting the validity of AR, which is a primary axiom of the mind (see Gödel's theorem). The product of the space-time of these two interacting entities, E_r and E_k, gives the total space time (energy) of the moving object E, which is the system resulting from this interaction. In this case we obtain the *momentum* of the object, which is a fundamental quantity in classical mechanics:

$$E = E_r\, E_k = m\mathsf{v} = \mathrm{SP(A)}[1d\text{-}space\text{-}time] = momentum = p \quad \text{(A-20)}$$

In physics, momentum is expressed as a vector, which is a [1*d-space*]-quantity. Its method of definition is the geometry of Euclidean space. This axiom holds not only for quantities, but also for the definition of all traditional laws in physics, which are applications of the universal equation. For instance, the paradigm „elastic collision" is a hidden application of AR and CAP; it is a frequent paradigm for the formulation of different laws and their applications. A typical example is the law of conservation of momentum, which is a subset of CAP. When the space-time of two moving systems, E_1 and E_2, is described as momentum, $m_1\mathsf{v}_1$ and $m_2\mathsf{v}_2$, their product gives the space-time of the resultant system from this interaction, which is conventionally described as elastic collision:

$$E = E_1\, E_2 = m_1\mathsf{v}_1\, m_2\mathsf{v}_2 =$$

$$= \mathrm{SP(A)}_1[1d\text{-}space\text{-}time]_1 \times \mathrm{SP(A)}_2[1d\text{-}space\text{-}time]_2 = \mathrm{m}\mathsf{v}^2 \quad \text{(A-21)},$$

where $m = m_1 m_2$ and $\mathsf{v}^2 = \mathsf{v}_1\mathsf{v}_2$ according to AR, or in short:

$$\boldsymbol{E = \mathrm{SP(A)}[2d\text{-}space\text{-}time] = E_A\, f} \quad \text{(A-22)}$$

Equation (A-22) is another equivalent presentation of the Law within the geometric formalism of traditional physics and can be substituted by any other spatial presentation. It illustrates the possibility of expressing the Law with descriptive terms of mathematical character. As most traditional laws are derived within geometry by employing AR, we shall frequently encounter this two-dimensional expression of space-time, for instance as the quantity „work" $W = Fs = \mathrm{SP(A)}[2d\text{-}space\text{-}time]$, where $F = ma$, $m = \mathrm{SP(A)}$, $a = \mathrm{d}\mathsf{v}/\mathrm{d}t = [1d\text{-}space\text{-}time]\, f$, and $\mathrm{s} = [1d\text{-}space]$.

When we substitute v for *c* in (A-22), we obtain Einstein's famous equation on the equivalence of mass (space-time relationship) and energy (space-time) $E = mc^2$. According to PCA, this equation is an application of the Law for the space-time *E* of any system, given in relation to the reference space-time $c^2 = [2d\text{-}space\text{-}time]$ of the photon level $m = \mathrm{SP(A)} = E/c^2$. The space-time of any system *E* can be compared to the space time of the photon level $E_p = m_p c^2 = c^2 = [2d\text{-}space\text{-}time]$ when the photon mass m_p is defined as „1 unit" or as the „certain event" $m_p = \mathrm{SP(A)} = 1$. This mathematical approach reveals why photon mass has been neglected in physics - it is already in the velocity of light as a system of reference. In physics, the square speed is also defined as a potential or gradient (see *LRC* below).

From (A-22) we obtain the following axiomatic presentation for the **action potential** within geometry:

$$E_A = E/f = \mathrm{SP(A)}[2d\text{-}space]\ f =$$

$$= \mathrm{SP(A)}[1d\text{-}space\text{-}time][1d\text{-}space] \qquad \text{(A-23)}$$

The two-dimensional presentation of the space-time of the resultant system is a product of the one-dimensional expression of the space-time of the interacting entities as momentum. Two vectors described as lines are multiplied according to AR to give a vector product. This geometric quantity is presented as „area", when the time of the resultant system is set as $f = 1$. Alternatively, space-time exchange can be regarded as an action potential and presented as „**area in motion**" (A-23) within geometric formalism. This presentation results from the method of measurement in Euclidean space. It can be substituted by any [*n-d-space*]-presentation. Many conventional laws and definitions of physical quantities follow the paradigm „area in motion", for instance electric current is defined as „charge (area) in motion" (see Mathematical Appendix).

Charge is Area - „Area in Motion" is Electric Current (Action Potential)

„Area in motion" is an intuitive notion of the Law within geometry which is frequently used in the formulation of specific laws. For instance, the laws of electricity are ontologically derived from this paradigm. We shall

prove that charge, another fundamental term of physics, is a synonym for area, while the SI unit for charge „1 *coulomb*" is equivalent to „1 *square meter*" (see Mathematical Appendix). This crucial pleonasm has been overlooked in physics. In a vicious circle, the quantity *electric current* is then defined as „area in motion". This quantity is a subset of the new term „action potential" (A-23).

The Long Range Correlation (*LRC*) is a New Quantity of Great Practical Relevance

Within the new axiomatics, a new term is introduced, called the „**long range correlation**" (*LRC*). It is a square velocity as obtained by AR within geometry $v^2 = v \times v = LRC$. It assesses space-time (A-22) in a static way:

$$E_{static} = [2d\text{-}space\text{-}time] = long\ range\ correlation\ (LRC) =$$

$$= gradient = potential \qquad \text{(A-24)},$$

when SP(A) = 1. The term „long range correlation", which is also used in traditional physics, acquires a new clear-cut definition. The quantity *LRC* is axiomatically derived from the primary term - it is an abstract U-subset of space-time when the latter is regarded in a static way and energy exchange is mentally ignored. The method of definition (= method of measurement) of this abstract quantity is mathematics. In this case, the mass (energy relationship) of any particular system is described as the certain event SP(A) = m = 1 or 1 unit and is not expressed in the equation.

We introduce this term for practical reasons - there are many different quantities in physics that are synonyms for *LRC*. For instance, the quantity *electric gradient* or *potential* is a concrete *LRC*. It assesses the space-time of the systems as a potentiality that can be transformed into an actuality, that is, into energy exchange by the free will of our mathematical consciousness. This transformation occurs in the mind and not in the real world - space-time is incessant energy exchange. According to AR, any system of space-time can be assessed as a result of the interaction between two other systems and any assessment is an interaction *per se*. We may assume that a system is not interacting (closed system); for exam-

ple, we may take a capacitor potential that does not discharge. In this case, we can only describe its space-time if we compare it with itself in an abstract way. Any other measurement, for example with a voltmeter, will be a discharge, no matter how infinitesimal. However, a self-comparison is also an interaction - it is a metaphysical interaction that occurs in the mind by means of mathematics. If we describe the system with the quantity mass, we can set its mass in relation to itself and obtain the certain event within mathematics by applying PCA: $m/m = SP(A) = 1$. This is the actual definition of „mass at rest“. As all systems are in motion, there is no such thing as „mass (or energy) at rest“. This quantity is a mathematical convenience and merely expresses the „certain event“ in physics.

The Reciprocal Behaviour of Contiguous *LRCs* of a System

According to AR, any system can be regarded as consisting of two levels (U-subsets). The space-time of these levels can be expressed as *LRC*. In this case, the two *LRCs* of the system manifest the reciprocity of space and time. When the *LRC* of the first level increases, the *LRC* of the second level decreases and vice versa. This also follows from the axiom of CAP, which is another equivalent statement on the reciprocity of space and time. The reason for this reciprocal behaviour of contiguous gradients is that the space-time of the system is constant - it is a U-subset of the constant and closed space-time. This approach is very useful in describing the dynamic behaviour of real systems. We shall use this axiom extensively in volume III to explain the biological regulation of the cell and the organism.

The reciprocal behaviour of *LRCs* has been anticipated in mathematics by the introduction of negative numbers, which are complementary to the continuum of real numbers. To any real positive number we can assign an equal negative number. Thus the continuum is designed as a formal system, which constitutes two levels that behave reciprocally - the continuum of positive numbers and the continuum of negative numbers. Zero (von Neumann’s set) is an abstract limit (intercept) between the two sets, but this symbol can be replaced by any other number.

The New Quantity „Structural Complexity, K_s"

The modern physical outlook on nature is dominated by wave-particle dualism. In fact, this is a dualism of the static and dynamic point of view. This dualism is not a real property of space-time, as is generally believed today, but an abstract mathematical discrimination. Space-time exchange is always dynamic - its universal manifestation is motion. The dynamic view is thus the only correct perception of space-time. The static view is an abstract idea (object of thought) based on a „mathematical trick". For this reason a new quantity is introduced in the new axiomatics that expresses the static view in physics. It is called „**structural complexity**" (K_s). This quantity is an abstract subset of space-time and is defined as the total set of all static perceptions in physics and science. It is actively established in the mind when the constituent „time" is *arrested*. The arrest of time occurs within mathematical formalism by assigning it the number „1" as 1 *unit* or the certain event $f = 1$:

$$E = E_A f = \mathrm{SP(A)}[2d\text{-}space\text{-}time] = \mathrm{SP(A)}[2d\text{-}space]\, f^2 \quad \text{(A-25)}$$

When $f = \mathrm{SP(A)} = 1$:

$$K_s = \mathrm{SP(A)}[2d\text{-}space] = \textbf{area relationship} \quad \text{(A-26)}$$

Time is the constituent of space-time that assesses energy exchange quantitatively: $E \approx f$. Therefore, the universal equation $E = E_A f$ assesses space-time from the dynamic point of view. K_s assesses the other constituent *space*, which stands for the static view. Within geometry, it is usually defined as an area relationship, just as mass is defined as a space-time relationship. K_s embodies the geometric approach to space-time as static space, e.g. as Euclidean space, Minkowski's world, Hilbert's space, etc. For this reason, there are many conventional quantities in physics that are pleonasms of K_s. The most prominent is charge $Q = K_s$. When we set $[2d\text{-}space] = \mathrm{SP(A)} = 1$, we can express $K_s = \mathrm{SP(A)}$. Therefore, we can also express charge as $Q = \mathrm{SP(A)}$ within mathematical formalism. The new quantity K_s effects another great simplification in our physical outlook, as summarized below:

1. $E = E_A\, f$ = SP(A)[2*d-space-time*] - **Universal equation**, dynamic expression of space-time

2. K_s = SP(A)[2*d-space*], $f = 1$ - **Structural complexity**, static expression of space-time

3. $E_A = K_s\, f$ = SP(A)[2*d-space*] f - **Action potential** (*area in motion*), dynamic expression of space-time

The three basic equations of the new axiomatics express the dynamic-static view of the world as embodied in the wave-particle dualism in physics. They show that the constituent „time" assesses the primary term dynamically as energy exchange (motion), while the constituent „space" assesses it statically in terms of geometry.

Every Motion in Space-time is Rotation

Space-time is closed. The closed character of the primary term is manifested by its U-subsets (systems, levels), which contain the nature of the primary term as an element. Thus, any motion, being the universal manifestation of energy exchange, is also closed. Within mathematical formalism it can be described as rotation, e.g. as a circular or elliptical motion. Any rotation can be regarded as a system or an action potential. The static mathematical expression of such rotations makes use of circles (e.g. wave function), ellipses (Kepler's laws), or any other closed geometric figure - hence the frequent use of the transcendental *pi*-number in physics (e.g. $h / 2\pi = \hbar$).

As all U-subsets of space-time are open, all rotations are superimposed. The principle of superposition (electromagnetism and quantum mechanics) reflects the open character of the systems. Translation is a mathematical abstraction of rotation with a very large extent: when [*space*] $\rightarrow \infty$, [1*d-space*] $\rightarrow$ straight line. This is the abstract origin of the co-ordinate system of Euclidean space or of any other geometric space based on straight lines or right angles. The closed character of space-time proves the interception of parallel lines in infinity (solution of the parallel axiom) in an *a priori* manner. The proof of existence is the conservation of energy. This proof cannot be given within geom-

etry. We shall show that not only classical mechanics (Newton's laws for rotations and wave equations) and electromagnetism (Maxwell's four equations), but also quantum mechanics (Bohr's model, Schrödinger wave equation) assess the micro- and macrocosm as superimposed rotations. This knowledge effects another great simplification in our physical outlook.

Finally, it is important to observe that there is no way of discriminating between rotations and waves in real terms. When a rotation is regarded as a solitary event, while the other superimposed rotations are disregarded in an abstract sense, the centre of rotation is considered a fixed (motionless) point. In this case, we describe a closed rotation, such as a circular motion. For instance, by disregarding the rotation of the earth around the sun, we can present the earth's revolution around its own axis as a closed rotation. When the elliptical rotation of the earth around the sun is considered, the path of any point on the earth represents a wave. As all rotations are superimposed, we only have waves. Hence de Broglie's correct notion of the wave character of matter. This effects another great simplification in physics.

The Continuum of Transcendental Numbers is the only Adequate Perception of Space-time

Any mathematical expression of space-time is based on real numbers. For instance, the transcendental number *pi* is expressed as a real number $\pi \cong 3.14$, which is an arbitrary approximation. All physical quantities in physics, e.g. all natural constants, are expressed in terms of real numbers, which are mathematical approximations of real magnitudes. Mathematics has virtually no theory of how to use transcendental numbers for practical applications. This fact is of great theoretical importance. Real numbers are N-sets, they exclude themselves as an element. For instance, the set of all „2" numbers is „1 set" and not „2 sets". The number „2" excludes all numbers that approximate 2, e.g. 2.000000001. Such numbers are called „closed numbers" analogously to the closed systems in physics. They exclude all contiguous approximations along the continuum. On the other hand, transcendental numbers are defined as „open numbers" - each transcendental number, such as *pi*, contains infinite approximations, which are closed real numbers. All systems of space-time are open U-subsets of space-time.

Thus the only adequate presentation of real U-subsets of space-time within mathematics is the use of open transcendental numbers. These numbers adequately assess the continuousness and infinity of space-time. In the theory of sets, the continuousness and infinity of the continuum (tautology due to PLE) is proven with the existence of transcendental numbers, which cannot be counted (12). In a vicious circle, the continuum of transcendental numbers is then visualized by means of the continuousness of the infinite points on a straight line, although neither „point“ nor „straight line“ can be defined within geometry (10). In the new axiomatics, the „existence“ of transcendental numbers is proven with the transcendence (continuousness and discreteness) of space-time (proof of existence in the real world). It should be stressed again that present-day mathematics (and science) has virtually no method of employing transcendental numbers for the real world.

For obvious reasons, all the numerical results which we present in this publication are closed real numbers - they are mathematical approximations reflecting the current degree of precision in the measurement of physical quantities. The method of measurement of modern physics is based on the *a priori* decision to employ exclusively the continuum of closed real numbers. This is accomplished by assigning to any real system of reference the primary closed number „1“ as 1 *unit* in the SI system, e.g. 1 kg, 1 joule, etc., or as the certain event SP(A) = 1, e.g. in the standardisation condition of Schrödinger wave equation, etc. According to PCA, all physical magnitudes are measured and expressed as relationships to this number and are thus closed real numbers $n/1 = n$. Thus the precision of any experimental result is predetermined by the method of definition of the quantities and their units (objects of thought), which is mathematics. Therefore, all the numerical results of constants and other physical quantities which we shall present below merely reflect the current method of definition and degree of precision of measurement in experimental physics. Their exactness is, however, irrelevant to the validity of the new axiomatics. Nonetheless, the accuracy of our numerical results is powerful evidence for the ubiquitous validity of the new axiomatics. The mathematical appendix that follows will summarize the basic applications of the Universal Law in physics and cosmology. The most common abbreviations used in this volume are:

AR	-	Axiom of Reducibility
CAP	-	Conservation of Action Potentials, axiom of
K_s	-	Structural complexity
Law	-	Universal Law
LRC	-	Long-Range Correlation
PCA	-	Principle of Circular Argument
PLE	-	Principle of Last Equivalence
RT	-	Rule of Three (universal equation)
UE	-	Universal Equation

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MATHEMATICAL APPENDIX OF THE NEW PHYSICAL AXIOMATICS

1. CLASSICAL MECHANICS

1.1 MATHEMATICAL METHODS OF PRESENTING SPACE-TIME

In classical mechanics, real systems of space-time are presented as spaceless particles of mass, called **mass points** (objects of thought). Displacement [1*d-space*] is given as a vector. The **average velocity** is expressed geometrically as:

$$\mathsf{v}_{\mathrm{av}} = \frac{x_2 - x_1}{t_2 - t_1} = \frac{\Delta x}{\Delta t} = [1d - space]f = [1d - space - time] \qquad (1)$$

or by differential calculus:

$$\mathsf{v} = \lim_{\Delta t \to 0} \frac{\Delta x}{\Delta t} = \frac{slope - tan\,gent - line}{x - versus - t - curve} = \frac{dx}{dt} = [1d - space - time] \quad (2)$$

The limit is called the derivative of x with respect to t. Differential calculus is a mathematical operation to assess the reciprocity of space and time. The idea of diminishing conventional time to the infinitely small number $\Delta t \to 0$ leads to increasing (absolute) time f that approaches the infinitely great number $\Delta f \to \infty$. Infinity can also be expressed with the number „1“ or a relation thereof (PLE) - hence $f \to \infty = 1 = \infty/1$. By arresting time $f = cons.$, we acquire the space-quantity of a gravitational object in motion as a **constant** static magnitude that is specific to each

system of space-time under observation. This is the origin of the static view of classical mechanics. From (2) we obtain the **instantaneous acceleration** as the second derivative with respect to time $f^2 = 1/t^2$; d^2 stands for f^2 (see also Nabla and Laplace operators in 4.6):

$$a = \lim_{\Delta t \to 0} \frac{\Delta \mathsf{v}}{\Delta t} = \frac{d\mathsf{v}}{dt} = \frac{d(dx/dt)}{dt} = \frac{d^2x}{dt^2} = [1d - space]f^2 \qquad (3)$$

Classical mechanics assesses motions with *constant* acceleration, which is a mathematical quantity of the constant E_A. This quantity is central to Newton's laws. Motion with changing acceleration is approximated to motion with constant acceleration by employing the same differential procedure as described for instantaneous velocity. The solution of motion with constant acceleration leads to the building of functions with **one** unknown variable - this can be **displacement** $x = x_0 + \mathsf{v}_0 t + 1/2at^2$, **velocity** $\mathsf{v}^2 = \mathsf{v}_0^2 + 2a\Delta x$, or **conventional time** $t = 2\mathsf{v}_0/a$. The Law $E = E_A f$ is a function with one unknown variable $y = ax$ because space-time is closed and the parts are U-subsets that contain themselves as an element. It is always possible to reduce a mathematical function to $y = ax$ in the real world by selecting a real system as a reference and assigning it the number „1" as 1 *unit* or the certain event (PCA).

The opposite operation to differential calculus is integration. The transitiveness of mathematical systems lies in their common origin of space-time. The PLE: energy = space-time is a commutative law. While we obtain velocity and acceleration functions from a given position function in geometric space by differentiation, we are at once confronted with the inverse problem of finding the position function x given the velocity v or acceleration a. To solve this problem of transition from dynamics to statics, the initial time t is selected as zero. This is a pure convention of mathematics (object of thought) - zero time t_0 is without any physical correlate.

This leads to two wrong assumptions that extend throughout physics. The first one postulates that we are in a position to determine exactly the „**initial conditions**" of gravitational motion as a subset of energy exchange. In reality, the „**initial-value problem**" of classical mechanics is a purely mathematical formalism based on unclear primary terms. The partial solution of this problem has given rise to the conviction that we can always find the position of a particle in space-time uniquely at all

other times if we know the forces acting on a particle and the position and velocity of the particle at some particular time. The latter is set at zero in an *a priori* manner (deterministic approach).

This is a self-delusion. Firstly, the solution of the initial value-problem takes place within the geometric space of mechanics, which is empty and homogeneous. This space is not equivalent to space-time, which is continuous and discrete. Secondly, all real gravitational objects have volume (space) - they are not spaceless mass points. Thirdly, zero conventional time has no real physical meaning: if $t = 0$, then $f = 1/t = 1/0$, which is „indefinite“ in terms of mathematics. It is no coincidence that this operation is forbidden in mathematics, although no explanation has been given for this. In real terms, time f will approach the infinitely great number $f = \infty/1$ or the certain event $f = \infty/\infty = \mathrm{SP(A)} = 1$, when t approaches zero.

These forms of presentation are mathematical iterations of the primary axiom. They assess the limits of any mathematical or physical knowledge. These very limits have been chosen in classical mechanics to assert that the initial-value problem of gravitational interactions can be exactly solved, while this task is not possible in the microcosm of quantum mechanics, as embodied in the **Heisenberg uncertainty principle**. This is the most preposterous presumption ever stated in physics - since all U-subsets of space-time are open, this would mean that we are in a position to measure exactly all energy interactions in space-time at once.

This has led to the second essentially wrong assumption in physics, namely, that conventional time is “reversible“. It is generally believed that the initial-value problem can be solved for any time, including time points in the past and in the future. **Reversibility of time** has been correctly regarded as a central paradox in the outlook of modern physics that is apparently contradictory to the notion of space-time evolution. In the new axiomatics, time is an abstract mathematical U-subset of space-time without any real meaning. This eliminates the problem of reversibility as an artefact. The geometric presentation of space-time quantities in classical mechanics is an inconsistent mathematical formalism. It can be summarized in the following **vector-scalar rule**:

> Any quantity expressed in the new [*space-time*]-formalism that contains velocity as a U-subset is conventionally defined as a vector, e.g. velocity $\mathsf{v} = [1d\text{-}space\text{-}time]$, momentum $p = \mathrm{SP(A)}[1d\text{-}space\text{-}time]$, etc. This also holds for [1*d-spa-*

ce]-quantities, while [2*d-space*]-quantities are either regarded as scalars, e.g. charge $Q = K_s$ = SP(A)[2*d-space*] or vectors, e.g. area as a vector. Time-quantities (*f*-quantities), such as temperature $T = f$ (see 3.1) and frequency $f = f$, as well as quantities which are direct relationships of energy (space-time) of the systems, such as mass $m = E_x / E_r$ = SP(A) = $K_{x,r}$ (see 1.8, 1.9 & 6.4), are defined as scalars. Energy (space-time) E = SP(A)[2*d-space-time*] is also defined as a scalar (static quantity).

1.2 NEWTON'S LAWS AND THEIR APPLICATIONS

The modern version of **Newton's three laws** is as follows:

Law 1. An object continues in its initial state of rest or motion with uniform velocity unless it is affected by net external force, called the resultant force $F_{net} = \Sigma F = 0$. This law, also called the **law of inertia**, is a special case of the second Law. It holds true in **inertial reference frames** and cannot discriminate between rest (immobility) and motion with uniform velocity (v = *cons*.). This means that the law of inertia is only valid in inertial reference frames. This is a mathematical tautology (vicious circle). As space-time = energy (PLE), there is no place in real space-time where no energies or forces are exerted - hence F is never zero. There are no real inertial reference systems in space-time - for instance, all gravitational systems rotate (Kepler's laws) and have a centripetal acceleration. Therefore, the law of inertia is not valid in real space-time, but only in **empty** Euclidean space, which is imagined to be void of forces (vacuum, N-set) within geometry. The latter is a hermeneutic discipline of the mind. For this reason, the law of inertia is abolished in the new axiomatics. Its epistemological background is explained in 6.1 & 6.3.

Law 2**.** The acceleration of an object is inversely proportional to its mass and directly proportional to the net external force acting on it:

$$a = F_{net}/m = \text{SP(A)}[1d\text{-}space\text{-}time]\ f\ /\text{SP(A)} =$$

$$= [1d\text{-}space\text{-}time]\ f \qquad (4)$$

Newton's second law can be expressed as a **law of energy** within mathematics:

$$E = F\Delta s = \text{SP(A)}[2d\text{-}space\text{-}time] =$$

$$= \text{SP(A)}[1d\text{-}space\text{-}time]\ f = F, \text{ when } \Delta s = 1 \qquad (5)$$

Law 3**.** Forces always occur in pairs. If object *A* exerts a force on object *B*, an equal but opposite force is exerted by object *B* on object *A* (**actio et reactio**). We shall add to this law: this interaction is independent of whether the objects of matter are in direct contact, or whether they are acting on each other at a distance. In the latter case, they are connected through the photon level, as space-time is continuous and consists of U-subsets. The third law is an application of CAP for the quantity force $F = ma = \text{SP(A)}[1d\text{-}space\text{-}time]\ f$. It is an intuitive perception of the reciprocity of *LRCs* of contiguous levels.

Our sensation of weight comes from this *actio et reactio;* for instance, sitting on a chair, we feel the force (energy) $E_{reactio} = E_{A1}$ exerted by the chair on our body that balances our weight $E_{weight} = E_{A2}$ and prevents us from falling to the floor $E_{reactio} = E_{A1} = E_{actio} = E_{A2}$. Thus „weight" is a circumlocution for the energy exchange between two contiguous material objects. In the condition of weightlessness, e.g. in a free fall, E_{weight} is completely transformed into the kinetic energy of the falling object $E_{kin} = 1/2m\mathrm{v}^{2}_{max}$ in space-time. This is the space-time of the photon level when the atmosphere is excluded. Thus any gravitational interaction abides by the axiom of CAP when *actio et reactio* are interpreted in terms of two interacting action potentials (AR):

$$E_{weight} = F\Delta s = E_{A2} = E_{kin} = 1/2m\mathrm{v}^{2}_{max} = E_{A1} \qquad (6)$$

Equations (4) to (6) confirm that the three laws of Newton are mathematical derivations of UE for the gravitational level of space-time.

Hooke's law is an application of Newton's laws for elastic contact forces. F_x is called **restoring force**. When we solve this law for the **force constant *k*** of a spring:

$$k = \frac{F_x}{dx} = \frac{\mathrm{SP(A)}[1d - space - time]f}{[1d - space]} = \mathrm{SP(A)}\, f^2 = \mathrm{SP(A)}\,,$$

$$\text{as } f = f^n = \ \mathrm{SP(A)} \qquad (7),$$

we obtain a constant quantity k that is square time f^2 and belongs to SP(A). It is specific for each spring. The new axiomatics says that the space-time of any system is constant (U-subset) because space-time is closed and constant. In this case, the time of any system is also constant $E \approx f = cons$. This is a consistent axiomatic conclusion from the nature of space-time (PLE). The same holds true for the space of any system. This conclusion is confirmed by all physical results without exception. Hooke's law (7) is an application of UE for the quantity time within mathematics.

Elastic matter is a paradigm of elastic medium, from which the concept of „**elastic ether“** has been developed. This concept was basic to classical electromagnetism (Lorentz, Maxwell). It was refuted by Michelson and Morley in an experiment based on false assumptions. However, the elastic ether is an intuitive, partially correct perception of photon space-time (see 6.2). For this purpose, we shall prove that Hooke's law, being an application of Newton's laws, is a partial solution of the **General continuum law** that holds in any elastic matter. This law is the differential form of UE as a **wave function** (2.4 & 4.14). Thus we shall prove that gravitation is a vertical energy exchange between two continuous and contiguous levels - matter and photon level - which are of the same character and abide by the Law. In this way we shall eliminate the present concept of gravitation as an „action at a distance in vacuum“. This will be substantiated by the derivation of many new fundamental constants (see below). The General continuum law represents the simplest mathematical model of contiguous action (action by contact) that is propagated by a transversal wave in an elastic medium, e.g. in a string continuum.

Consider the simple differential equation of deformation $d = u/s$, where u is the transverse displacement of the particle and s is the original distance between the particles. We can write the **restoring force** F_x as a function of deformation:

$$F_x = pd = p\frac{u}{s} = p\frac{[1d-space]_1}{[1d-space]_2} = p\frac{f_2}{f_1} = pf \qquad (8),$$

where p is the so-called **elastic constant.** Observe that the quotient of two times is also time $f = f_2 / f_1$. From equation (8), we can obtain the dimensionality of the abstract quantity p by employing the new space-time symbolism:

$$p = \frac{F_x}{f} = \frac{\mathrm{SP(A)}[1d-space-time]f}{f} =$$

$$= \mathrm{SP(A)}[1d-space-time] = momentum \qquad (9)$$

The elastic constant p is a pleonasm of momentum, which is a one-dimensional space-time quantity. In this appendix, we shall come across many mathematical pleonasms (tautologies) in physics, which can be recognized as such for the first time by employing the new space-time symbolism. They are the main cause of the present cognitive mess in this discipline. The quantity p is a specific constant of each elastic medium - this quantity assesses the constant space-time of the elastic system. This is a proof for the constancy of space-time as manifested by the parts (empirical validation of the new axiomatics).

When we apply equation (9) to all particles in a string continuum and transform it accordingly, we obtain a differential equation of the second order:

$$\rho b = pc = \mathrm{SP(A)}\, f^2 \qquad (9a),$$

where ρ is the **linear density** of mass $\rho = \mathrm{SP(A)}/[1d\text{-}space]$ (47), $b = (v - v_1)/t = a$ (4) is the change of velocity to conventional time, and $c = (d - d_1)/a$ is the change of deformation from point to point; a is the acceleration of the mass particle. The square time f^2 indicates the order of differentiation. Equation (9a) is an iterative presentation of the force constant in Hooke's law $\rho b = pc = k = \mathrm{SP(A)}\, f^2$(7). We shall show in 1.7 that equation (9a) is identical to a novel derivation of the law of gravity, which we call the „universal equation of gravitation" (41). The latter is an application of the Law for gravitational systems.

1.3 WORK AND ENERGY IN MECHANICS

Newtonian mechanics has selected „force“ as a major quantity of space-time. For this reason energy is of secondary importance to this discipline. It is introduced in a circular manner through the anthropocentric concept of “work“: “When work is done by one system on another, energy is transferred between the two systems.“[1] One defines the **work** ***W*** done by a force on an object as the product of the force and the displacement of the point on which the force acts (UE for gravitational energy):

$$W = F_x\Delta x = \text{SP(A)}[1d\text{-}space\text{-}time]\ f \times [1d\text{-}space] =$$

$$= \text{SP(A)}[2d\text{-}space\text{-}time] = E \qquad (10)$$

Work is regarded as a „scalar“, although it is obtained as a product of two vectors, force $F_x = A$ and displacement $\Delta x = B$: $W = F_x\Delta x = A \times B$ (dot product). Here we come across a basic inconsistency of geometric formalism in physics - points and straight lines are voluntarily ascribed to physical quantities (see vector-scalar-rule in 1.1). As energy contains velocity v^2, it should be regarded as a vector. However, it is defined as a scalar. It is precisely this definition of energy as a scalar, that is, as work, which has precluded the assessment of the primary term as an interacting, inhomogeneous entity of motion, from which all secondary terms, such as scalars and vectors, are mathematically derived. Such mathematical inconsistencies hinder the development of a unified theory of physics and must be eliminated from a theoretical point of view.

Work is defined through **kinetic energy** by employing velocity as the universal quantity of motion: $W = E_{kin} = 1/2mv^2{}_{max} = mv^2{}_{\text{mean}} = \text{SP(A)}[2d\text{-}space\text{-}time]$ (PLE). Motion is assessed one-dimensionally as a result of constant forces - the interaction of two motions expressed as momentum results in kinetic energy (AR). If the work is done by variable forces, it is usually assessed as structural complexity $K_s = \text{AUC}$, area-under-the-curve ([2*d-space*]-quantity):

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[1] PA Tipler, p. 135-136.

$$W = \int_{x_1}^{x_2} f_x dx = \mathrm{SP(A)}[2d - space - time] = \mathrm{SP(A)}[2d - space] = K_s =$$

$$= \text{area under the } F_x - \text{versus} - x \text{ curve} \qquad (11),$$

In this case, $f = \mathrm{SP(A)} = 1$ is regarded as an accomplished static quantity. Gravitational energy is also assessed in terms of potential energy (static view): $\mathrm{d}U = (-)Fds = \mathrm{SP(A)}[2d\text{-}space\text{-}time]$ (UE). The minus sign is a pure mathematical convention: space-time is termless. Another frequent presentation of potential energy is $U = 1/2kx^2$, which is a derivation of Hooke's law (7) for the primary term when applied to an elastic medium, e.g. to a string.

In classical mechanics, energy is subdivided into "**conservative**" and "**dissipative**" energy (forces). When a system is defined in an abstract way as closed (object of thought), we have a conservative energy, when the system is open - a dissipative energy. However, all systems are open - therefore, any particular energy exchange (U-subset of space-time) is dissipative. Only space-time is closed, that is, conservative. As all systems of space-time manifest the whole as an element, they reflect the conservative character of space-time. This is a clear-cut explanation in terms of knowledge - that of the primary term.

Classical mechanics has produced a vast array of ideas on energy, such as the concept of "**equilibrium**" and "**disequilibrium**", that vitiate the present physical outlook: „(1) A particle is in equilibrium if the net force acting on it is zero. (2) In stable equilibrium a small displacement results in a restoring force F_x that accelerates the particle back toward its equilibrium position. (3) In unstable equilibrium a small displacement results in a force that accelerates the particle away from its equilibrium position. (4) In neutral equilibrium a small displacement results in zero force so the particle is again in equilibrium"[2].

Ontologically, these descriptive statements are unprecise circumlocutions of Newton's laws. Note: all the erroneous concepts in physics are of a non-mathematical nature. Statements (1) and (4) are iterations of the first law: if $F = 0$, then the object is at rest (1) or moves with a constant velocity (4). The law of inertia is rejected in the new axiomatics (see 6.1). Statements (2) and (4) are descriptions of Hooke's law and its

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[2] PA Tipler, p. 152-153.

generalized form - the General continuum law. As we see, the four statements are superfluous iterations of well known laws, which are derivations of the Law, and should not be interpreted any further to suit popular beliefs.

Mechanics considers **conservation of energy**, which is an aspect of the closed character of space-time. This gives rise to a slight confusion, as this law is actually defined through **heat** in thermodynamics (3.4). Instead of defining the conservation of energy by PLE, it is defined by the parts (circulus viciosus). This is a serious deficiency of physics from an epistemological and didactic point of view. The **law of conservation of mechanical energy** confirms the constant character of space-time:

$$E = E_{kin} + U = \text{constant} \tag{12}$$

In mechanics, there are many mathematical iterations of the primary axiom as expressed in (12), e.g. the „generalized work-energy theorem“. With one exception, we shall not discuss these: the **law of conservation of energy** is presented in mechanics in a generalized form that anticipates the „input-output model“ of space-time as developed in the new axiomatics:

$$E_{in} - E_{out} = \Delta E_{sys} \tag{13}$$

From work (as energy), another abstract quantity is defined - the **power *P*:**

$$P = \frac{dW}{dt} = F\mathsf{v} = Ef = E_A f \quad \text{, when } E = E_A \tag{14}$$

The quantity power is a classic example of the creative potential of mathematical consciousness in defining new abstract quantities which are metaphysical U-subsets of the primary term. In reality, power does not exist - it is an abstract term of mathematics. The only real thing is energy: each system has a specific constant amount of energy, which can be assessed by the quantity „power“ within mathematics.

The „conservation of momentum“ is another central theme in mechanics that is closely linked to the concept of “mass particle“ or „centre of mass“. Within geometry the method of definition of this term is inte-

gral calculus. The term, centre of mass, is an abstract construction that facilitates the presentation of motion (energy exchange) in a co-ordinate system. The cognitive problems which one encounters when this idea is applied to the real world have been discussed above.

This is also true for the concept of „elastic collision", which has been introduced as an abstract closed system with respect to momentum. On the other hand, the idea of „inelastic collision" acknowledges the priority of reality over fiction. It considers the fact that all systems are open and participate in the cosmic energy exchange, e.g. by emitting photons. Collisions can be assessed in one, two, or three dimensions (degree of mathematical freedom).

The tautological character of physics in inventing new physical quantities, which are mathematical pleonasms, is underlined by the **impulse *I*.** This quantity is defined as the total change in momentum during the time interval *dt*:

$$I = \int_{t_i}^{t_f} F dt = \int_{t_i}^{t_f} \frac{dp}{dt} dt = p_f - p_i = \Delta p = \mathrm{SP(A)}[1d - space - time] =$$

$$= momentum \qquad (15),$$

where the difference Δ (measurement) goes in SP(A). These are the essentials of mechanics.

1.4 SPACE-TIME OF ROTATIONS

Mechanics departs from linear motion, also called „translation", which can be without acceleration ($a = 0$ and $v = cons.$) or accelerated ($a = cons.$ or $a = variable$). The law of inertia holds in linear motion with no acceleration: when $F = 0$, then $a = 0$. The second law describes motion with constant acceleration $F > 0$ and $a = cons.$, e.g. in a free fall: $a = g = cons.$ The free fall approximates linear motion. In reality, any free fall is part of a circular motion when the rotation of the earth on its axis and its revolution around the sun are considered:

> **Every real motion in space-time is rotation. „**Circular motion" is a frequent idealization of physical rotation wi-

thin geometry. Hence the frequent use of *pi* in physical formulae. „Linear motion“ is an abstraction of rotation when the radius is said to approach infinity $r \to \infty$. Rotation is the universal manifestation of the closed character of space-time through its parts (e.g gravitational objects and particles).

The knowledge that every motion of space-time is rotation is central to the new axiomatics. The conventional presentation of rotation reflects this fact. Although the physical quantities describing rotation are very similar to those of linear motion, there are some fundamental mathematical differences that should be explained. They are important for an understanding of electromagnetism and quantum mechanics, as these disciplines describe rotations.

Rotation introduces a new term, called **angle** $d\theta$. It is defined as the arc length ds_i divided by the radius r_i, $d = ds_i / r_i$, according to PCA. All real space-quantities are relationships - in this case, the angle is a [1*d-space*]-quantity. Such relationships are constant magnitudes. The angle $d\theta$ swept across by a radial line in a given time is the same for all particles on the disc. It is therefore called the **angular displacement** $\Delta\theta$ and is measured accordingly (method of definition = method of measurement):

$$\Delta\theta = \frac{2\pi r_i}{r_i} = \frac{\left[1d-space\right]_1}{\left[1d-space\right]_2} = \mathrm{SP(A)}\left[1d-space\right] =$$

$$= \frac{f_2}{f_1} = \mathrm{SP(A)} = 2\pi rad = 360° = 1rev \qquad (16),$$

where *rad* for radiant and *rev* for revolution are units of angular displacement. These angular units can be obtained from the unit “degree“ (^{o}) by conversion factors which are pure numbers. SP(A) stands for the difference Δ (measurement). However, when SP(A) = 1, this symbol may not be expressed. In this case, $\Delta\theta$ is [1*d-space*]. We shall come across this procedure quite often. The angle is a [1d-*space*]-quantity, which is usually presented as a pure number belonging to *n* or SP(A). This inconsistent approach is also observed in the presentation of other quantities

of rotation. It is a major pitfall in physics. The rate of change of the angle with respect to t is called **angular velocity**:

$$\omega = d\theta/dt = [1\text{d-}space\text{-}time] = \mathsf{v} \tag{17}$$

Angular velocity is often expressed as reciprocal conventional time $1/t = f$, thus leading to cognitive flaws. The **angular acceleration** α is equivalent to linear acceleration a (3):

$$\alpha = \frac{d\omega}{dt} = \frac{d^2\theta}{dt^2} = [1d - space - time]f = [1d - space]f^2 \tag{18}$$

Equation (18) confirms the consistency of the new axiomatic approach $d^2 = 1/t^2 = f^2$. Differential calculus is transitive to geometry in expressing the primary term: the number of dimensions corresponds to the order of differentiation. Angular acceleration is usually given as square time $f^2 = 1/t^2$. This shows that geometry is inconsistently applied in mechanics. From the angular velocity, the **tangential velocity** $\mathbf{v_{it}}$ can be easily obtained:

$$\mathsf{v}_{it} = r_i\omega = \frac{ds_i}{dt} = \frac{r_i d\theta}{dt} =$$

$$= \text{SP(A)}[1d - space] \times [1d - space - time] = E_A \tag{19}$$

SP(A) stands for differentiation, which is a measurement (metaphysical energy interaction). In the new axiomatics, the tangential velocity is an **action potential of rotation** $\boldsymbol{E_{Arot}}$. However, in conventional physics it is comprehended as velocity. This also causes serious cognitive problems. From the tangential velocity, one can define the **centripetal acceleration** $\boldsymbol{a_{ic}}$:

$$a_{ic} = \frac{\mathsf{v}_{\text{it}}^{\,2}}{r_i} = \frac{(r_i\omega)^2}{r_i} = r_i\omega^2 =$$

$$= \text{SP(A)}[2d - space - time] \times [1d - space] = Es = E_A\mathsf{v} \tag{20}$$

The dimensionality of the centripetal acceleration is identical to that of the electric flux ϕ in Gauss's law (4.12). The reason for this is that electromagnetic waves are transversal waves, which can be regarded as products of rotations (see section 2).

When the primary term is applied to rotation, it is known as **torque** τ_i. It is defined as the product of a force F_i and the axis of the rotation called „lever arm" ***l*,** which it exerts on an object. This [1*d-space*]-quantity is usually expressed as a position vector r_i with respect to the angle φ: $l = r_i sin\varphi$:

$$\tau_i = F_i l = F_i r_i sin\varphi = \text{SP(A)}[1d\text{-}space\text{-}time]\ f\ [1d\text{-}space] =$$

$$= \text{SP(A)}[2d\text{-}space\text{-}time] = E \qquad (21)$$

The derivation of the torque is a concrete application of Newton's second law for circular motion and leads directly to UE. Once energy of rotation is defined, the classical abstract quantity mass (space-time relationship) can be introduced (see 1.8 & 1.9). Its method of definition and measurement is mathematics - classical mechanics employs the same procedure as that used to obtain the centre-of-mass $M\mathrm{R}_{cm}$ of objects as a vector $M\mathrm{r}_{cm} = \Sigma m_i r_i$. In the case of rotation, mechanics resorts to its degree of mathematical freedom and defines mass not as a linear quantity (see density in (47)), but as an area, e.g. as mass (energy) distributed on a disc area. This hidden definition departs from the angular acceleration and obtains force $F_{it} = m_i r_i \alpha$ and torque $\tau_i = m_i r_i^2 \alpha$ as a function of this quantity. The product $m_i r_i^2$ is defined in a tautological manner as the **moment of inertia *I***. It is equivalent to the new universal space-quantity, structural complexity $K_s = \text{SP(A)}[2d\text{-}space]$, to which the quantity „mass" is ontologically ascribed $m = \text{SP(A)} \Rightarrow K_s$, when $[2d\text{-}space] = 1$:

$$I = \Sigma m_i r_i^2 = \text{SP(A)}[2d\text{-}space] = K_s \qquad (22)$$

The moment of inertia I is a physical quantity of space-time defined within mathematics. It represents the static view of the world. K_s can be expressed as SP(A) when $[2d\text{-}space] = \text{SP(A)} = 1$ is defined as the certain event or as a mass point. When we set $K_s = \text{SP(A)} = m$, we get for the torque the dimensionality of force $\tau_i = I\alpha = \text{SP(A)}[1d\text{-}space\text{-}time]\ f = F$. This example illuminates why one often speaks of forces

in physics, but always means energy (space-time). From the torque, further pleonasms of rotational space-time are introduced. One of them is **rotational work:**

$$dW_i = \tau_i \, d\theta = E_A f \qquad (23),$$

where $\tau_i = E = E_A$, when $f = 1$ (degree of mathematical freedom), while the angle $d\theta = \mathrm{SP(A)} = f$ can be expressed as time, that is, as a pure number. Another basic quantity is **angular momentum** $\boldsymbol{L}$, which is broadly used in electromagnetism and quantum mechanics ($\omega = f$):

$$L = m\mathrm{v}r = mr^2\omega = I\omega =$$

$$= \mathrm{SP(A)}[1d\text{-}space\text{-}time][1d\text{-}space] = E_A \qquad (24)$$

Angular momentum is **rotational action potential**. According to the new axiomatics, it is a constant amount of space-time. Rotational mechanics establishes exactly this result. By applying Newton's second law to rotations, it iterates the law of conservation of momentum defined for the linear motion for the torque $\tau_i = dL/dt = E = E_A f$. The net external torque acting on a system equals the rate of change of the angular momentum of the system. Alternatively: if the net external torque acting on a system is zero, the total angular momentum of the system is constant. One always assesses the primary term in the pluripotent variety of physical phenomena.

1.5 KEPLER'S LAWS

Kepler's laws are concrete applications of the Law in respect of gravitational rotation. They are geometric solutions of empirical data (Ticho Brahe), and are thus intuitive perceptions of the Law. Newton's law of gravity is, instead, a generalized mathematical derivation of Kepler's laws. Kepler's laws say: **Law** 1. All planets move in elliptical orbits with the sun at one focus. **Law** 2. A line joining any planet to the sun sweeps across equal areas in equal times. **Law** 3. The square of the period of any planet is proportional to the cube of the planet's mean distance from the sun.

The first law recognizes that real rotations are never ideal circular motion. The „*n*-body problem“ of gravitational orbits (Lagrange, Poincaré) reveals that there is no closed solution of gravitation for more than two bodies (three-body-problem). As all systems of space-time are open and exchange energy, we have in reality an *n*-body problem, where $n \rightarrow \infty$ symbolizes the continuum. The actual orbit of a gravitational body is an oscillating path around „libration points“, which cannot be periodically solved, although partial solutions have been proposed by various authors.

Kepler's first and second law depart from the definition of angular momentum $L = m\mathrm{v}r = E_{Arot}$ (24). If one considers the mean distance r of the planet from the sun, as is done in the third law, it transpires that this [1*d-space*]-quantity is constant for each planet (constant space-time of systems). The statement of Kepler's second law that this radial line sweeps across equal distances in equal times is an iteration of our axiomatic conclusion on the constancy of space and time for the parts. In this case, the constancy of space-time is assessed as structural complexity, that is, as area. This law is an application of PCA. We can build an equivalence by assigning to any distance, area, or time interval of gravitational rotation the number 1 as a unit or the certain event and comparing these reference quantities with any other voluntarily selected distance, area, or time of rotation. From the rotational action potential of the planet, one can easily obtain the **structural complexity** of this gravitational system:

$$L = m\mathrm{v}r = E_{A,rot} = \mathrm{SP(A)}[2d\text{-}space]\ f =$$

$$= \mathrm{SP(A)}[2d\text{-}space] = K_s = cons., \text{ when } f = 1 \qquad (25)$$

Here we encounter the classical dichotomy in the physical outlook of nature as dynamic energy and static geometric structure. In physics, one can only measure geometric structures, hence the reduction of space-time to the geometry of space. Energy can only be counted, for instance, as *n* [joules], where the unit of space-time, 1 *joule*, is an action potential „1 E_A “ (see 3.4). It is a constant amount of energy (building of equivalence) that has been voluntarily selected as a reference unit to compare the space-time of any other system (building of relationships according to PCA).

The approximation of elliptical orbits to circular motion is the method of definition and measurement of Kepler's third law $T^2 = Cr^3$ for the

planet's **period** *T* of revolution. As space-time - in this particular case, we are dealing with gravitational space-time - has only two constituents, space and time, one can only assess these two quantities. While Kepler's second law assesses the mean area of rotation as a quantity of space, his third law solves for the time $f = 1/T$ of the planet's rotation. ***C*** is a specific constant that has the same value for all planets around a sun. Its magnitude depends exclusively on the space-time of the sun, which determines the gravitational properties of the solar system, while the effects of the planets can be neglected. When Kepler's third law is obtained from Newton's law of gravity $T^2 = \frac{4\pi^2}{GM_s} r^3$, we acquire for the **constant *C***:

$$C = \frac{4\pi^2}{GM_s} = \frac{\mathrm{SP(A)}}{F} = \frac{\mathrm{SP(A)}}{\mathrm{SP(A)}[1d - space - time]f} = \frac{1}{\alpha} \qquad (26),$$

where *G* is the **universal gravitational constant** and M_s is the mass of the sun. *F* is the gravitational force which the sun exerts on the planet to induce its revolution. According to AR, this force results from the interaction between the two entities. The universal gravitation is given as *G* (29) and the gravitational space-time of the sun as M_s. This is Newton's 2nd law, which is constant for each rotation $F = M_s G = \mathrm{SP(A)}[1d\text{-}space\text{-}time]\, f$. The constant *C* is reciprocal angular acceleration (18). The full elaboration of equation (26) will be performed in the next chapter.

1.6 NEWTON'S LAW OF GRAVITY IS A DERIVATION OF THE UNIVERSAL EQUATION (New Derivations)[3]

Newton derived his famous **law of gravity** from Kepler's laws. We shall follow Newton's honourable tradition and derive his law of gravity from the Universal Law. The law of gravity is a derivation of Newton's second law within mathematics: both laws describe gravitational space-time

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[3] From now on, whenever we present a new derivation that is not known in physics, we shall use the abbreviation (ND) in the title.

with the quantity *force*, which is an abstract U-subset of the primary term:

$$g = \frac{F_g}{m} = \frac{GM}{r^2} = [1d - space - time]f \tag{27}$$

In this equation, M is the mass of any particular gravitational system. As Newton's law claims universal validity, we can choose any system of space-time, including space-time itself, and set its hypothetical gravitational mass M in the above equation. According to the cosmological principle, which is an application of PCA, mass (energy) is evenly distributed in the universe. This is a pure mathematical approximation to the mean value. In reality, there are clusters of galaxies separated by large photon spaces with no visible gravitational mass. Space-time can be described by Einstein's equation $E = mc^2$, which we have shown to be a mathematical iteration of the Law. We write for the **mass of space-time**: $M = E/c^2 = E/LRC_p$ = SP(A). Space-time (the universe) has an extent, which we define as infinite. By applying PLE, we can set the symbol „1" for its [1*d-space*]-quantity $r = 1$. All actual space-quotients, which we obtain in space-time, are thus smaller than „1" and belong to the probability set. If we set „1" for r in the denominator of the right term GM/r^2 in (27), we obtain the product GM. We can now express M by Einstein's equation $M = E/c^2$ and obtain a new derivation of equation (27):

$$GM/r^2 = GM = GE/c^2 \tag{27a}$$

We now consider the left term of equation (27), which gives the gravitational acceleration of the earth $g = F_g/m$. When we rewrite this equation for the primary term, we obtain the formula of the **universal gravitational acceleration** (4):

$$g_U = F_U/M = [1d\text{-}space\text{-}time]\, f = [1d\text{-}space]\, f^2 \tag{27b}$$

As gravitation is exerted at a distance through photon space-time with the speed of c, we may as well speak of "universal gravitational field" E_G. Another common quantity of photon space-time is the gravitational potential $LRC_U = c^2 = [2d\text{-}space\text{-}time]_p$. According to the cosmological

principle, we can regard gravitational space-time as the aggregated mean product (U-set) of all particular gravitational fields or potentials in the universe, such as the gravitational potentials of our sun and the earth. The number of all gravitational systems in space-time (universe) is infinite. As the space-time of any system or level is constant, the universal gravitational acceleration of photon space-time should be constant too - it is a U-subset that exhibits the properties of the whole. The speed of light *c* is the universal quantity of photon space-time when it is regarded as motion or energy exchange. It is a fundamental natural constant. We can therefore set *c* for [1*d-space-time*] in the formula of g_U (27b) and obtain the Law for one-dimensional photon space-time (E_A = [1*d-space-time*]):

$$g_U = cf = [1d\text{-}space\text{-}time]\, f = E_A\, f \tag{27c}$$

We do not know the value of time *f* in this equation. As space-time is infinite, all levels, such as the photon level, have the power of the continuum and are also infinite. Therefore, the time *f* must approach infinity, that is, space-time is eternal. This is the utmost limit of any human knowledge as embodied by the primary term. If we now set the terms, GE/c^2 from (27a) and *cf* from (27c), in Newton's law of gravity as presented in equation (27) and solve it for the **energy** (space-time) *E*, we obtain a **novel derivation** of this famous law:

$$E = \frac{c^3}{G}\, f = E_{AU}\, f \tag{28}$$

> **Newton's law of gravity** is a derivation of the Universal Law**.** Equation (28) holds for the gravitational level of space-time. The quotient $E_{AU} = c^3/G$ is called the **universal action potential E_{AU}**. It is a **new** fundamental cosmological constant that can be experimentally measured (30).

The gravitational level is per definition a U-subset of the photon level - equation (28) contains only quantities of photon space-time (*c* and *G*) as time can be set at „1". E_{AU} is constant, because it is a quotient of two natural constants, *c* and *G*. If we express the universal action potential in equation (28) in the new space-time symbolism E_{AU} = SP(A)[2*d-space*] *f*,

we obtain for the **universal gravitational constant *G*** the following dimensionality:

$$G = \frac{c^3}{E_{AU}} = \frac{[3d - space - time]}{\mathrm{SP(A)}[2d - space]f} = \frac{1}{\mathrm{SP(A)}}[1d - space - time]f =$$

$$= [1d - space - time]f = g_U, \text{ when } \mathrm{SP(A)} = 1 \qquad (29)$$

> The **universal gravitational constant** *G* in Newton's law of gravity is a physical quantity that is equivalent to the **gravitational acceleration** g_U or **field** E_G of the photon level $G = g_U = \mathsf{E}_G$. It is a quantity of photon space-time built within mathematics.

All constants are U-subsets of the primary term. The gravitational constant *G* can be experimentally measured in a free fall exerted by the earth's gravitation *g* when the classical law of gravity is applied:

$$G = \frac{F_g r^2}{m_1 m_2} = \frac{F_g r^2}{m} = \frac{\mathrm{SP(A)}[1d - space - time]f\,[2d - space]}{\mathrm{SP(A)}[2d - space]} =$$

$$= [1d - space - time]f = g_U \qquad (29a),$$

where $m_1 m_2 = m = \mathrm{SP(A)}[2d\text{-}space] = K_s$ (AR). The fact that a simple local experiment renders the universal quantities (magnitudes) of photon space-time proves the closed, interrelated character of space-time. We do not need to perform expensive experiments in astrophysics to gain information on the universe. E_{AU} proves that we can obtain all useful information on the universe from known natural constants that can be exactly measured (see Table 1). This is also true for the new cosmological constant E_{AU} (28):

$$E_{AU} = \frac{c^3}{G} = \frac{(2.9979246 \times 10^8)^3 [\mathrm{ms^{-1}}]^3}{6.6726 \times 10^{-11} [\mathrm{m^3 kg^{-1} s^{-2}}]} = 4.038 \times 10^{35} [\mathrm{kgs^{-1}}] \qquad (30)$$

> The **universal action potential** $E_{AU} = c^3/G$ assesses the vertical energy exchange between the photon level and the gravitational level, also defined as "matter". Both levels are U-subsets of space-time that contain themselves as an element and cannot be separated in real terms. The gravitational mass of the magnitude of 4.038×10^{35} kg per second is exchanged between the two levels. The **gravitation** between material objects, defined as horizontal energy exchange of *attraction*, is exerted through this vertical energy exchange (U-sets).

The consistency of the new axiomatics is *confirmed* by equation (30). We attribute mass ontologically to K_s = SP(A)[2*d-space*] as $f = 1$. When the space of a system is regarded as the certain event [2*d-space*] = SP(A) = 1, that is, as a centre of mass, we can also write $m = K_s$ = SP(A). As the method of definition and measurement of mass employs the second procedure 1 kg = K_s = SP(A) = 1, we usually find mass in traditional physical equations as an energy relationship, to which the symbol SP(A) can be attributed. However, there are some derivations that require the full expression of mass as structural complexity. For instance, the volume of the universal action potential in (30) is approximately equal to that of a galaxy. This volume can hardly be reduced to a spaceless centre of mass, as is done for other gravitational objects in classical mechanics. If we write equation (30) in the new space-time symbolism, we obtain the classical space-time presentation of the universal action potential as „area in motion" (A-23):

$$E_{AU} = [\mathrm{kgs}^{-1}] = \mathrm{SP(A)}[2d\text{-}space]\, f \qquad (30a)$$

Equation (30a) proves that we can express the SI units in the space-time symbolism and acquire consistent results and vice versa. This transitiveness of mathematical expressions is inherent to any axiomatic system, such as mathematics or the new axiomatics, as they have their origin in the primary term. The universal action potential is an important natural constant that can be easily derived from Newton's law of gravity when it is expressed in the generalized form of UE. It plays a central role in cosmology. With the help of this quantity, we shall refute the standard model and prove that the universe, that is, space-time, does not expand (7.3).

1.7 THE ONTOLOGY OF NEWTON'S LAW FROM CONSCIOUSNESS - A PARADIGM OF HOW PHYSICAL LAWS ARE INTRODUCED IN PHYSICS (ND)

The new axiomatics is based on the primary term, which is the only real thing. All further terms are abstract concepts of the mind, which are derived from it in a consistent way within mathematics. We shall show that the new axiomatics is **transitive**: for example, it is possible to depart from the primary term and define Newton's law of gravity in an axiomatic way without performing any experiments. We have already proved that this law assesses the primary term of our consciousness (28). Therefore, it can be deduced from the mind - the ontology of this law is human consciousness. Vice versa, it is possible to confirm this deductive law experimentally, for example, by measuring the gravitational constant G in a free fall in the earth's gravitation. The latter is a particular system of the gravitational level.

The deduction of Newton's law of gravity from the mind is paradigmatic for the definition of most traditional physical laws (e.g. Coulomb's Law). Thus logical deduction, as embodied in the present axiomatics, and empiricism, as materialized in current scientific research, are two dialectical aspects of the unity of space-time. However, the Universal Law establishes the priority of logic over action in an irrevocable manner.

Consider an energy interaction E between two macroscopic gravitational objects defined as „attraction" according to AR: $E = m_1 m_2$. In classical mechanics, such objects are depicted as structural complexity K_s, that is, as mass points or mass particles, m_1 and m_2, in geometric space (1.1). The symbols, m_1 and m_2, have no particular meaning - they stand for the space-time of the interacting objects and can be substituted by any other symbol. The new axiomatics states that energy exchange can be assessed, if we consider time $f = E/E_{A^{\cdot}}$, which is the dynamic constituent of space-time. This follows from the inhomogeneous character of space-time - it manifests itself through discrete action potentials. We have proved that we can introduce infinite variables to the universal equation without impairing its validity. Therefore, we can introduce the time of the objects, f_1 and f_2, to equation $E = m_1 m_2$ without affecting PLE:

$$E = m_1 f_1 m_2 f_2 \tag{31}$$

Time can be assessed by the reciprocal conventional time $f = 1/t$. Conventional time is measured in conjunction with space, that is, as velocity, which is the universal quantity of motion. If $t = r/v$, then $f = v/r$ (r = distance). We set $f = v/r$ in equation (31) and obtain:

$$E = m_1 \frac{v_1}{r} m_2 \frac{v_2}{r} = \frac{m_1 m_2 [2d - space - time]}{[2d - space]} \tag{31a}$$

Observe that the above operations are performed within mathematics and do not need any experimental evidence whatsoever. Equation (31a) is now solved for the force $F = E/s = E/[1d\text{-}space]$, as this quantity is the preferred one in Newton's law of gravity:

$$F = \frac{[2d - space - time]}{[1d - space]} \times \frac{m_1 m_2}{[2d - space]} \tag{32}$$

We apply this equation to the photon level (see 1.6), which is the mediator of gravitation as vertical energy exchange. The term [2*d-space-time*] in the numerator is the *LRC* of the photon level $LRC = c^2$. In this case, the [1*d-space*]-quantity in the denominator assesses the extent of the photon level as a distance. All gravitational objects are, so to say, embedded in the photon level, which we perceive as universe or cosmos. This level is infinite, because it has the power of the continuum. However, our knowledge of the universe is restricted to the **visible universe**. The extent of the visible universe is determined by its **event horizon**.

The visible universe is thus an actual constant system of space-time. Its event horizon is defined in cosmology as [2*d-space*]-quantity - as a spherical area, within which the maximum escaping velocity of galaxies is equivalent to the speed of light $v_{esc} = c$. The escaping velocity is greater than c beyond the event horizon of the visible universe, so that the light from such galaxies can no longer reach the observer. This is a conclusion from **Hubble's law**, which is basic to cosmology - it is a simple application of the Law for the system „visible universe" (see 7.2).

The term „event horizon" is a pleonasm of K_s of the visible universe. As the space-time of the systems is constant, the extent (space) of the

visible universe is also constant. This property of the whole is manifested through the parts.

This phenomenon is intuitively reflected by the so-called „cosmological principle“ (Mach, Einstein, Milne). It postulates that the universe is the same for any observer, that is, the event horizon of the visible universe is constant for any observer at any place, at any time in the universe. In other words, we have infinite visible universes of constant space and time, because we can imagine infinite observers in space-time. This is an important mathematical application of PLE in cosmology (see section 7.).

The [1*d-space*]-quantity in the denominator of equation (32) is therefore the **circumference S_U** of the event horizon of the visible universe**.** It is a basic cosmological constant. The second [2*d-space*]-quantity in the denominator assesses the square distance r^2 between any pair of gravitational objects in space-time (AR). We can set the conventional symbols of these physical quantities in equation (32):

$$F = \frac{c^2}{S_U} \times \frac{m_1 m_2}{r^2} = G \frac{m_1 m_2}{r^2} \tag{32a}$$

and obtain **Newton's law of gravity** from the primary term. This mathematical presentation has been axiomatically deduced from the primary term of our consciousness by applying the axioms AR and CAP. The quotient:

$$G = c^2/S_U = 6.6726 \times 10^{-11}\ \mathrm{ms}^{-2} \tag{33}$$

can be experimentally determined, e.g. in a free fall. We obtain as a result the famous **universal gravitational constant** *G*, which cannot be integrated with other natural constants in traditional physics. In equation (33), *G* is a function of $c^2 = LRC_p$ and S_U. On the other hand, the speed of light is given as a function of the **permettivity** ε_0 and **permeability** μ_0 **of free space** (= photon space-time) in Maxwell's equation of electromagnetism $c^2 = 1/\varepsilon_0\mu_0$. These constants appear in all laws of electricity and magnetism, respectively in Maxwell's four equations of electromagnetism. From this it becomes cogent that the new application of UE (33) is the **key to the integration of gravitation with electromagnetism** (see below).

The above result confirms that empiricism is nothing but a tautology of the Law. Equation (33) illustrates the basic statement of the new axiomatics, saying that all we can do in physics is to compare the space-time of one system defined as a reference system with the space-time of another system (PCA). In Newton's law of gravity, the space-time of the photon level is selected as a system of reference: both $LRC = c^2 = [2d\text{-}space\text{-}time]$ and $S_U = [1d\text{-}space]$ are natural constants (quantities) of reference that belong to photon space-time. In Newton's law of gravity, these quantities are compared with the space-time ($E = m_1m_2$) and space ($r^2 = [2d\text{-}space]$) of any particular gravitational interaction between two material objects (AR). The result of this interaction is regarded as a new distinct system. In fact, Newton's law of gravity is an RT. The choice of the physical quantities in such presentations is voluntary - within mathematics, we can define an infinite number of abstract secondary quantities of space-time (degree of mathematical freedom) - hence the seeming diversity of physical laws. For instance, we can obtain the **radius of the visible universe** $\boldsymbol{R_U}$ from the circumference S_U in equation (37) within geometry as follows:

$$R_U = S_U /2\pi = 2.14 \times 10^{26} \text{ m} \tag{34}$$

This is another **new** cosmological constant of fundamental importance. The actual dimensionality of the universal gravitational constant G as given in (33) is that of acceleration (3):

$$G = \frac{[2d - space - time]}{[1d - space]} = g_U = [1d - space - time]f =$$

$$= [1d\text{-}space] \tag{35},$$

For this reason we also call it the „**universal gravitational acceleration**" $g_U = G$ (29). When we set $f^2 = \text{SP(A)} = 1$, we can also express G as a *distance* (static approach).

The ontology of Newton's law of gravity from our mathematical consciousness is paradigmatic for other laws. For example, we can trace the same pattern of presentation in **Coulomb's law** $F = kq_1q_2/r^2$, which is a basic law of electricity. Its similarity to the law of gravity was acknow-

ledged a long time ago, although no logical explanation has been forwarded for this remarkable coincidence. The reason for the similar expression of the two laws is the application of AR. In the new axiomatics, we regard mass and charge as abstract U-subsets of the primary term that belong ontologically to the mathematical set „structural complexity“ m and $q \Rightarrow K_s$ (“$\Rightarrow$“ is a symbol for “belonging“). However, charge and mass are not identical quantities: m is an energy relationship, while charge is an area relationship. The **Coulomb constant** $k = 1/4\pi\varepsilon_0 = \mathsf{E}_0/4\pi$ is a subset of the primary term that is defined within geometry and has the same dimensionality as G (see also 4.3):

$$k = \frac{\mathsf{E}_o}{4\pi} = \frac{[1d - space - time]f}{4\pi} = circle - area = \frac{circumference^2}{4\pi} =$$

$$= A = \frac{u^2}{4\pi} = \frac{[2d - space]}{[1d - space]} = [1d - space] \Rightarrow G_{static} \Rightarrow g_{U(\,static\,)} \quad (36),$$

when $f^2 = \mathrm{SP(A)} = 1$ (see (35)). Recall that *pi* is a [1*d-space*]-quantity which is expressed as a dimensionless number in physics (inconsistency of mathematics). The geometric approach of Coulomb’s law is cogent. The formula of Coulomb constant is borrowed from the geometry of the circle: the area of circle A (corresponds to k) can be expressed as square circumference u^2 (corresponds to the electric field of the photon level $\mathsf{E}_0 = 1/\varepsilon_0$) divided by 4π (see 4.4). We can use the same geometric method to obtain the **circumference** S_U of the event horizon of the visible universe from equations (33) & (34):

$$S_U = \frac{c^2}{G} = \frac{U_U}{G} = \frac{a_p \lambda_A}{g_U} = 2\pi R_U = 13.47 \times 10^{26}\ \mathrm{m, when}\ f = 1\ \mathrm{or}$$

$$g_U S_U = a_p \lambda_A \quad (37)$$

λ_A is the *wavelength* of the basic photon h (see 1.8 & 1.9); a_p is its acceleration. Equation (37) is of fundamental importance for an epistemological understanding of the Universal Law. It contains the following essential truth:

The **extent** (**space**) of the visible universe, as assessed by its constant circumference S_U (event horizon), is proportional to the $LRC = c^2$ of the photon level, also defined as the universal potential $U_U = c^2$, and inversely proportional to the universal gravitational constant G that has the dimensionality of acceleration:

$$S_U = c^2/G \tag{37a}$$

This is, indeed, a remarkable result. We can regard the constant space of the visible universe as the product of two **dialectically linked, opposite forces or potentials**: 1) the universal potential of the photon level, which is responsible for the **expansion** of the universe and 2) the gravitational acceleration, which is responsible for the **attraction** (contraction) of the universe. This follows from the reciprocity of space and time. The space (extent) of the visible universe is thus not an *a priori* quantity of the physical world, as is believed in physics today - hence the elimination of empty geometric spaces in the new axiomatics - but a dynamic product of two reciprocal *LRCs*. Each system can be expressed as the product of two *LRCs* that behave reciprocally (AR). The reciprocity of contiguous *LRCs* reflects the reciprocity of space and time. In our particular case, we can write for the reciprocity of the *LRCs* of photon level and gravitational matter: $S_U G = U_G = (-)U_U = (-)c^2$. Both levels are U-subsets of space-time - they cannot be distinguished in real terms, but only within mathematics. This is the actual epistemology of gravitation as an „action at a distance". Alternatively, equation (37) can be interpreted as an application of Newton's third law of *actio et reactio* (AR).

If we rearrange Newton's law of gravity as expressed in formula (37), we obtain the universal equation as an RT:

$$g_U / a_p = \lambda_A / S_U \tag{38}$$

Equation (38) illustrates the reciprocal character of space and time. The acceleration of the gravitational level g_U and the acceleration of the photon level a_p, being one-dimensional quantities of space-time, g_U, and $a_p = [1d\text{-}space\text{-}time]\ f$, behave reciprocally in relation to their corresponding spaces as assessed by the wavelength of the basic photon λ_A and the circumference of the visible universe S_U.

Equation (38) is a prototype of another application of Newton's law

of gravity. We can solve this law for the earth's gravitation g in the following manner: $g = GM_E/R_E^2$. This is a well known formula that describes the earth's gravitation as a product of $G = g_U$ and K_s of the earth M_E/R_E^2. In this formula, R_E is the earth's radius and M_E is the earth's mass. The common mathematical origin becomes evident when we rearrange this equation:

$$g = U_G = G\frac{M_E}{R_E^{\,2}} = G\frac{4\pi R_E}{3}\left[\frac{M_E}{V_E}\right] = \frac{2}{3}GS_E\rho_E = \frac{2}{3}\frac{c^2}{S_U}S_E\rho_E \quad (39),$$

where $\rho_E = M_E/V_E$ is the density of the earth ($M_E = 5.98\times10^{24}$ kg, $R_E = 6.38\times10^6$ m, $V = 4/3\pi R_E^3$ = volume of the earth)[4], and $S_E = 2\pi R_E$ is the circumference of the earth. The quotient $2c^2/3S_U$ is a new **cosmological constant** $k_U = 2c^2/3S_U = 2/3G$, as $U_U = c^2 = cons.$ and $S_U = cons.$ (33):

$$g = U_G = k_U\, S_E\, \rho_E \quad (40)$$

The earth's gravitation can be expressed as $g = [1d\text{-}space\text{-}time]\, f$ or $U_G = [2d\text{-}space\text{-}time]$. Both quantities can be presented as equivalent mathematical terms $U_G = g\, f$; when $f = 1$, then $U_G = g$. In equation (40), the earth's gravitation g is a constant product of three other constant quantities. Indeed, all experiments confirm that g is constant.

Let us now assume that the universe expands, as is done in the standard model of cosmology. This would mean that S_U will increase. In this case, k_U will decrease. This would mean that the earth's gravitation will decrease as the universe expands. However, there is no evidence that g changes in a similar way. This is a very strong indication that the universe does not expand. This is also proven by the constant event horizon or circumference S_U of the visible universe.

Equation (40) is of paramount importance for celestial mechanics and cosmology. It describes a simple relationship between the **density** ρ_E as a fundamental quantity of physics (47) and the space (extent) of any particular celestial object, including the visible universe itself:

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[4] The data are from Kane & Sternheim's Physics, John Wiley & Sons, New York, 3rd ed., 1988, p. 62-63.

$$\rho_E = \frac{g}{k_U} \times \frac{1}{S_E} = \frac{U_G}{k_U} \times \frac{1}{S_E} = k \times S_E{}^{-1} \tag{41}$$

The **density** of gravitational objects is inversely proportional to their extent (space).

The new **constant of proportionality *k*** already contains the constant space-time of the visible universe, to which the space-time of any gravitational object can be compared. We have shown that this is precisely the objective of Newton's Law of gravity. In this case, $k = g/k_U$ is a constant because $g = U_G$ and k_U are also constants. Equation (41) holds for any gravitational object, such as planets, stars, black holes, or galaxies. We call it the „**universal equation of gravitation"** because it is the generalized form of Newton's law of gravity. For instance, we can apply it to **black holes**. These gravitational objects have the greatest density we know of. At the same time the event horizon of black holes as assessed by the circumference *S*, also known as „world line" (pleonasm), is extremely small. A black hole is usually described as a space singularity. The gravitational potential of black holes is proportional to their density $U_G \approx \rho_E$ (40). It is considered to be the maximum local potential of gravitation that occurs in space-time.

Exercise: The Radius and the Mass of the Earth are Functions of Photon Space-Time

Gravitation is a manifestation of the **vertical energy exchange** between the level of matter and the photon level. This energy exchange allows the comparison of the space-time of any material system to photon space-time. We have proved this for the SI units second and meter. Another fundamental system of the photon level which can be precisely quantified is the „visible universe“ with the circumference (event horizon) of $S_U = c^2/G$ (33). Therefore, we can use the visible universe as a system of reference to measure the space-time of any other system by employing the universal equation of gravitation (41). This approach has the following advantage: the visible universe has a constant extent for any observer in the universe (cosmological principle as PLE). It is the biggest system of space-time we know of. As all systems of space-time are U-sets, the visible universe includes all gravitational objects we can register, for instance, by the Hubble Space Telescope. Equation (37) contains the gravitational constant G of Newton's law of gravity. This fact demonstrates the possibility of employing the photon system „visible universe“ as a reference system for measuring the space, time, or space-time of any gravitational system within this system. This particular approach simplifies our cosmological outlook dramatically. For instance, we can obtain the radius of the earth from the space-time of the visible universe and vice versa. We can link the application of the Law for the visible universe $G = c^2/S_U$ (33) to Newton's application of the Law for the earth $G = gR^2/M$ (27), where R is the earth's radius and M is the earth's mass, and solve a new equation for the **earth's radius**:

$$R^2 = \frac{c^2}{S_U g} M = \frac{G}{g} M = \frac{[1d - space - time]f}{[1d - space - time]f} M = \mathrm{SP(A)}M =$$

$$= \mathrm{SP(A)}K_s = \mathrm{SP(A)} \times \mathrm{SP(A)}[2d - space] = \mathrm{SP(A)}[2d - space] \quad (41a)$$

Equation (41a) illustrates the inner consistency and absence of contradiction of the new axiomatics. We obtain the exact dimensionality for each abstract quantity of space-time, such as M (K_s), G, g, or R^2, because they have been axiomatically deduced from the primary term. It is im-

portant to observe that G contains the **total** information on photon space-time and can be easily obtained in a local experiment, such as the free fall. We shall prove that the same is true for the basic natural constants of electromagnetism, ε_0 and μ_0 (4.3), which contain valuable information on the space-time of neutron stars, black holes, etc. When we set the values for the natural constants, c^2, S_U, g, and M, in equation (41a), we obtain for the earth's radius the value of $R = 6377\times10^3$ m. In fact, the radius is a little bit smaller, as the earth is not an ideal sphere $R = 6370\times10^3$ m.

We can now depart from the radius and obtain the mass M of the earth. As with all definitions and exercises in physics, this calculation is based on PCA. This is a manifestation of the closed character of space-time. For this purpose, we take equation (29) $G = c^3/E_{AU}$ and express the universal action potential E_{AU} (30) with the quantity mass $E_{AU} = M_{AU} f_p$, where $f_p = 1\ s^{-1}$. We can express the speed of light by its constituents as given for the basic photon $c = \lambda_A f_p$, where $f_p = 1\ s^{-1}$. We obtain for the gravitational constant $G = c^2\lambda_A/M_{AU}$. When we link this equation to equation (27) and solve it for the **earth's mass,** we again obtain the same epistemological result: physics is a comparison of the space-time of physical systems or quantities thereof:

$$M = \frac{gR^2}{GS_U\lambda_A} M_{AU} =$$

$$= \frac{[1d - space - time]f[2d - space]}{[1d - space - time]f[1d - space][1d - space]} M_{AU} =$$

$$= \mathrm{SP(A)}M_{AU} \qquad (41b)$$

This application of the Law can be experimentally verified.

1.8 MASS AND MIND

Mass does not exist - it is an abstract term of our consciousness (object of thought) that is defined within mathematics. Mass is a comparison of the space-time of any particular system E_x to the space-time of a reference system E_r (e.g. 1 kg) that is performed under equal conditions, e.g. in the constant earth's gravitation (PCA): $m = E_x/E_r$ = SP(A), when $g = cons.$ Mass is a **static energy relationship** that does not consider energy exchange, although it is obtained from an energy interaction, e.g. weighing. This explains the traditional presentation of mass as a scalar. We can call the space-time of a reference system „1 *kg*" or „1 *space-time*" without changing anything in physics. In the new axiomatics, we ascribe mass for didactic purposes to the new term „structural complexity": when $f = 1$, $m = K_s$ = SP(A)[2*d-space*] = SP(A). In this case, [2*d-space*] = SP(A) = 1 is usually regarded as a spaceless „centre of mass" within geometry.

The definition of mass in classical mechanics is as follows: „Mass is an intrinsic property of an object that measures its resistance to acceleration."[5] The word „resistance" is a circumlocution of reciprocity: $m \approx 1/a$. This definition creates a vicious circle with the definition of force in Newton's second law: „A force is an influence on an object that causes the object to change its velocity, that is, to accelerate"[6]: $F \approx a$. From this circular definition, we obtain for the mass $m \approx 1/F$. If we consider the number „1" as a unit force, $F_r = 1$ (reference force), then we get $m = F_r /F$. This is the vested definition of mass as a relationship of forces. As force is an abstract U-subset of energy $F = E/s = E$, when s = 1 *unit*, e.g. 1 m, we obtain for the mass a relationship of two energies: $m = E_r /E$ = SP(A). It is important to observe that this definition of mass is equivalent to the definition of time $f = E/E_A$ = SP(A). From a mathematical point of view, mass can be regarded as a quantity of time. The definition of mass follows PCA. If we rearrange $m \approx 1/a$ to $ma = 1 = F = E =$ *reference space-time* (Newton's second law), we obtain PLE.

The equivalence between the **method of definition** of physical quantities and the **method of their measurement**, being mathematics in both cases, can be illustrated by the measurement of **weight** $F = E$ ($s = 1$).

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5 PA Tipler, p. 80.
6 PA Tipler, p. 80.

The measurement of weight is an assessment of gravitation as a particular energy exchange. The instruments of measurement are scales. With scales we weigh equivalent weights or gravitational forces $F_r = F_x$ at equilibrium; as $s = 1 = cons.$, $E_r = E_x$. This is Newton's third law (CAP) expressed as an energy law. The equilibrium of weights may be a direct comparison of two gravitational interactions with the earth, or it may be mediated through spring (elastic) forces. As all systems of space-time are U-subsets, the kind of interim force is of no importance: any particular energy exchange such as gravitation can be reduced to an interaction between two interacting entities (AR).

Let us now consider the simplest case, when the beam of the scales is at balance. In this case, we compare the energy E_r (reference weight) and E_x (object to be weighed), as they undergo equivalent gravitational interactions with the earth. The equivalence is visualized by the balance. This is an application of PCA - building of equivalence and comparison. Let us now describe both interactions according to AR. For this purpose, we express the two systems in the new space-time symbolism. The space-time of the earth E_E is given as gravitational potential $E_E = LRC_G = U_G = [2d\text{-}space\text{-}time]_G$. The space-time of the two gravitational objects, E_r and E_x, is given as mass: $E_r = m_r = \mathrm{SP(A)}_r$ and $E_x = m_x = \mathrm{SP(A)}_x$. As the two interactions (attractions to the earth) are equivalent, we obtain UE for each weighing:

$$E = E_r\, E_G = E_x\, E_G = \mathrm{SP(A)}_r[2d\text{-}space\text{-}time]_G =$$

$$= \mathrm{SP(A)}_x[2d\text{-}space\text{-}time]_G \tag{42}$$

We can now compare the two gravitational interactions by building a quotient:

$$K = \mathrm{SP(A)} = \frac{\mathrm{SP(A)}_x\left[2d - space - time\right]_G}{\mathrm{SP(A)}_r\left[2d - space - time\right]_G} =$$

$$= \frac{\mathrm{SP(A)}_x}{\mathrm{SP(A)}_r} = \frac{m_x}{m_r} = x\ \left[\mathrm{kg}\right] \tag{42a}$$

We obtain the Law as an RT. „Weighing" is based on the equivalence of the earth's gravitation for each mass measurement, i.e., $U_G = g = cons.$

If U_G were to change from one measurement to another, we would not be in a position to perform any adequate weighing, precisely, we would not know what the energy relationships (masses) between distinct objects really are.

Equation (42a) exemplifies how one obtains the „certain event" in physics: $m_r = m_x = 1$ kg $= m_x/m_r = \mathrm{SP(A)} =$ certain event $= 1$. If $m_x = \mathrm{SP(A)} \geq 1$, then the „1 *object*" to be weighed is equivalent to n [kg], that is, $1 = n$ (n = all numbers of the continuum). Within mathematical formalism, we can define any number of the continuum, which stands for a system of space-time, as the certain event and assign it the number „1". This mathematical procedure is fairly common in physics. We shall show below that the basic quantity „1 mole" is defined in the same way. Any definition of physical units, e.g. SI units, follows this pattern. The standard system of 1 kg contains, for instance, 1 000 g, 1 000 000 mg and so on. We can build an equivalence between the certain event „1" and any other number of n, such as 1 000 or 1 000 000, by adding voluntary names of units to these numbers, which stand for real systems of space-time: 1 *kilogram* = 1000 *gram*.

Thus the primary idea of space-time as a **conceptual equivalence** (PLE) is introduced in mathematics not through numbers (objects of thought), which are universal abstract signs, but through descriptive terms, such as „kilogram", „gram", and „milligram". These descriptive terms establish the link between mathematics and the real world. They are of precise mathematical character - when we apply PCA to the words „kilogram" and „gram", we obtain a dimensionless quotient *kilogram*/*gram* = 1000 that belongs to the continuum.

Instead of these voluntary units, we can choose the space-time of **Planck's constant** h as a unit of mass $E = h/c^2 = m_p = \mathrm{SP(A)} = 1$ by comparing it with itself. Alternatively, we can compare the space-time of this constant with the space-time of the standard system of mass called 1 kg and obtain a different quotient or dimensionless number (44). We can then express the mass of all material systems, for instance the mass of all elementary particles, in relation to the mass of h in [kg] and obtain the same values as assessed by direct measurements. The reason why these results agree is that mathematics is the only method of definition and measurement of mass (or of any other quantity).

Mathematics is a transitive axiomatic system due to the closed character of space-time - it works both ways. One can either depart from the definition of mass and then confirm it experimentally in a secondary

way, or assess mass as a space-time relationship of real systems and then formalize this measurement into a general definition of this quantity. In both cases, the primary event is the mathematical definition according to PCA.

As we can set $m_p = h/c^2 = 1$ or $m_p = (h/c^2) \times 1$ kg, the space-time of Planck's constant can be chosen as the initial reference system of mass measurement. This also follows from the fact that space-time has only two dimensions, the initial reference frame of which is photon space-time. All other units can be derived from these two units. This interdependence can be easily demonstrated by presenting the *Lorentz factor* of relativity (see 6.2 and 6.3) as an RT (see also (42a)):

$$y^{-1} = \mathrm{SP(A)} = \sqrt{\frac{c^2 - \mathsf{v}^2}{c^2}} = \sqrt{\frac{d\mathsf{v}^2}{c^2}} = \sqrt{\frac{dLRC_x}{LRC_p}} =$$

$$= \sqrt{\frac{\mathrm{SP(A)}\left[2d - space - time\right]_x}{\left[2d - space - time\right]_p}} =$$

$$= \frac{\mathrm{SP(A)}\left[1d - space - time\right]_x}{\left[1d - space - time\right]_p} = \frac{E_x}{E_p} = \frac{d\mathsf{v}}{c} = \frac{m_x}{m_p} = x \ \left[\mathrm{kg}\right] \qquad (43)$$

Equation (43) confirms that we can present space-time one-, two, or *n*-dimensionally without affecting the basic conclusion of our axiomatics. The only thing we can do in physics is to compare the space-time of one system, or a quantity thereof, with that of another system.

1.9 MASS, MATTER, AND PHOTONS (ND)

As the quantity „mass" is a space-time relationship, there are **infinite** masses in space-time. We shall derive some basic constant space-time relationships, which are conventionally described as „natural constants". Thus we shall prove that space-time is a closed entity so that we can derive any constant mass from any other constant mass. The same is true for the magnitude of any other quantity of an actual space-time relation-

ship. As such constants are part of distinct physical laws, which until now could not be integrated, we shall demonstrate how physics **can be unified** (see Table 1).

For this purpose we shall employ the new space-time symbolism and neglect the SI units, which obscure our knowledge of the primary term. The non-mathematical term „*kg*“ will be ascribed to the final result, so as to make clear that we have selected the space-time of 1 *kilogram* as a real reference system. The reason for this is the use of conventional data from the literature, which are given in SI units.

We begin with the **mass** m_p of h**,** which is a space-time relationship of this photon system with the SI unit, 1 kg. In the new axiomatics, we call Planck's constant h the „**basic photon“**. This smallest constant amount of photon energy is the elementary action potential of the photon level. The energy of any photon (electromagnetic wave) as a system of this level can be assessed by applying UE: $E = E_A f = hf = \mathrm{SP(A)}[1d\text{-}space\text{-}time][1d\text{-}space]\, f$. This proves that Planck's equation is an application of the Law for photon space-time. Each action potential can be regarded as a system of space-time. This also holds for the basic photon $h = E = \mathrm{SP(A)}[2d\text{-}space\text{-}time]_\mathrm{p}$. When we set its space-time in relation to photon space-time $E_p = c^2 = [2d\text{-}space\text{-}time]_\mathrm{p} = LRC_p$, we obtain the space-time relationship SP(A) of this elementary action potential as **mass** in *kg*:

$$m_p = \frac{h}{c^2} = \frac{h\mu_0}{4\pi k} = h\mu_0\varepsilon_0 = \frac{\mathrm{SP(A)}\left[2d - space - time\right]_p}{\left[2d - space - time\right]_p} =$$

$$= \mathrm{SP(A)} = 0.737\times10^{-50}\,\mathrm{kg} \qquad (44)$$

The **constant** m_p is the **mass** of the **basic photon**. It is a **new** fundamental constant obtained within mathematics; it assesses the constant space-time of this real photon system in relation to the real, surrogate SI system of reference „1 *kg*“ according to PCA. Equation (44) illustrates this principle, which is also basic to the Law: $f = \mathrm{SP(A)} = E/E_A = m$. The time and space of the basic photon are also natural constants: $f_p = 1\ \mathrm{s}^{-1}$ and $\lambda_\mathrm{A} = c/f_p = [1d\text{-}space\text{-}time]_\mathrm{p}/f = [1d\text{-}space]_\mathrm{p} \cong 3\times10^8$ m. According to PCA, we can alternatively select the wavelength λ_A of the basic photon as a reference unit of length and

compare the anthropocentric length unit of 1 m with it. In this case we obtain the conversion factor $A = 1\lambda_A/1\ m = 2.99792458\times10^8 = SP(A)$. As space-time is closed, we can depart from any magnitude and acquire any other magnitude and vice versa. The same is true for mathematics - continuum is space-time. We can obtain any number from any other number as a relationship. All the constants which we shall derive in this book belong to the continuum - they are dimensionless numbers (quotients).

Equation (44) integrates five basic physical constants by introducing the new constant m_p. These are: **speed of light** ***c***, **permeability of free space** μ_0, **permettivity of free space** ε_0, **Coulomb's constant** *k*, and **Planck's constant** *h* (see Table 1). These constants are part of distinct laws, such as Coulomb's law of electricity, Maxwell's equations of electromagnetism, Planck's equation of quantum mechanics, and Einstein's mass-energy-equation of his theory of relativity. So far, these laws cannot be integrated. We have already derived Planck's equation and Einstein's law from the universal equation. The five constants are abstract quantities of photon space-time and contain far more information about this level than is generally assumed (see μ_0 and ε_0 in 4.3).

Mass is a space-time relationship of systems, and space-time is a closed entity. We can depart from the basic photon and obtain the space-time *E* of any elementary particle of matter as „mass": $E/h = SP(A) = m$ and vice versa. This will be proven for **electron**, **proton,** and **neutron**. These elementary particles of matter are open systems and exchange energy - we can also speak of mass - with the photon level: they absorb and emit photons. There are several laws of radiation that describe this energy exchange (see thermodynamics). We depart from UE as an RT and make use of the **Compton wavelengths** of the particles, which are known natural constants. We shall derive only the **mass** of the **electron** $\boldsymbol{m_e}$. The mass of the other particles is obtained analogously:

$$K_{e,p} = \frac{E_e}{h} = \frac{m_e}{m_p} = \frac{\lambda_A}{\lambda_{c,e}} = \frac{[1d-space]_p}{[1d-space]_{c,e}} = \frac{f_{c,e}}{f_p} = \mathrm{SP(A)}\ \text{or}$$

$$m_e = \frac{m_p\lambda_A}{\lambda_{c,e}} = m_p f_{c,e} = 9.109\times10^{-31}\ \mathrm{kg} \qquad (45)$$

$\lambda_A = 2.99792458\times10^8$ m is the wavelength of the basic photon, $\lambda_{c,e} = 2.42631058\times10^{-12}$ m is the Compton wavelength of the electron, $f_p = 1$ (s^{-1}) is the time of the basic photon (assessed as a wave frequency), $f_{c,e} = c/\lambda_{c,e} = 1.23559\times10^{20}$ is the **Compton frequency** of the electron (a new constant), and m_p is the mass of the basic photon. By applying the Law, we obtain the mass of the electron. It is a basic constant that can be experimentally measured. The masses of the particles are basic not only to quantum mechanics, which is unable to explain their origin, but also to gravitation.

Although the mass of the particles is initially obtained in mathematics, this quantity can be experimentally verified. This holds true for all abstract physical quantities of space-time (unity of mathematics and physical world). We shall illustrate this basic insight of the new axiomatics with the classical experiment of **Compton scattering,** which assesses the vertical energy exchange between electron level and photon level. This time, we shall use the axiom of CAP. For this purpose we consider the electron and the basic photon as the elementary action potentials of two interacting levels, $E_e = m_e c\lambda_{c,e}$ and $h = m_p c\lambda_A$, by setting their time as the certain event $f_e = f_p = \mathrm{SP(A)} = 1 = 1$ *particle*. This formalistic approach allows the building of equivalence between any two action potentials (PLE for the parts):

$$E_e = h = m_e c\lambda_{c,e} = m_p c\lambda_A =$$

$$= \mathrm{SP(A)}[1d\text{-}space\text{-}time][1d\text{-}space] \tag{45a}$$

When we rearrange this equation by eliminating c, we obtain equation (45) as an RT:

$$m_p = \frac{m_e\lambda_{c,e}}{\lambda_A} = 0.737\times10^{-50}\ \mathrm{kg} \tag{45b}$$

Mass can be regarded as a magnitude that gives us information on the **density** of space-time (see 1.10) - the higher the density, the more energy (mass) per space. Figuratively speaking, space-time can be imagined as an accordion - the more folds per space (f), the higher the energy $E \approx f$. The Compton frequency $f_{c,e}$ of the electron is much greater than that of the basic photon $f_p = 1$, namely 1.23559×10^{20} times. The same holds for

its mass $m_e/m_p = f_{c,e}$. The space of the electron is correspondingly smaller than the space of the basic photon: $\lambda_{c,e}/\lambda_A = f_p/f_{c,e} = 1/1.23559 \times 10^{20}$. Such constants reflect the reciprocity of space and time - this reciprocity is inherent to all physical quantities of space-time.

Space-time (energy) is a dynamic, elastic entity (elastic continuum = ether) that can only expand or shrink in **quantitative leaps** when it is exchanged, but it never gets lost, because it is closed. In reality, the *expansion* and *contraction* of space-time are the actual manifestations of energy exchange, which is perceived as motion. For instance, the contraction of photon space-time is assessed as gravitational attraction at the material level. This is the common view of humans, who are part of the material level. In mechanics, this exchange is assessed by velocity, which is the universal quantity of the primary term. Expansion and contraction are the only manifestations of motion assessed in thermodynamics (e.g. ideal-gas laws). At present, physics assesses energy (space-time) statically as space or as any other quantity relationship, e.g. as mass or work. This is the reason why physicists have failed to develop an idea of space-time as a dynamic entity.

The concept of **matter** is such a static idea that has been developed in contrast to dynamic photon space-time. In the view of modern physics, electromagnetic waves represent structureless, massless energy, while matter implies mass and structure. Mass and matter are often used in the same connotation - Einstein's equation $E = mc^2$ is a typical example of this semantic tautology. In order to abolish this energy-matter dualism (or wave-particle dualism) conclusively, we shall show how the mass (energy relationship) of all macroscopic objects can be obtained from the mass of *h* within mathematics and only then confirmed in a secondary manner by empirical research.

We begin with the basic SI unit for the amount of substance „**mole [mol]**", where the term „substance" is used as a synonym for „matter with mass". A mole of any substance is defined as the amount of this substance that contains **Avogadro's number N_A** of atoms or molecules. We can regard the atoms or molecules of any substance as the action potentials E_A of this substance level E_{mol} called "mol-level", as they are considered to have a constant energy. The energy of the system „1 *mol*" can be expressed by UE: $E_{mol} = E_A N_A = E_A f$. Thus Avogadro's number N_A is the time f of the mol-level of any substance $N_A = f$. In accordance with the new axiomatics, it is constant for all substances (systems) of the *mol*-level. The SI unit „1 *mol*" is defined through N_A. It is an abstract

category that is built according to PCA, and, as with all other SI units, it requires the arbitrary selection of a real system of reference. Avogadro's number is defined as the number of carbon atoms in 12 grams of ^{12}C. The particular system „1 *mol*" is a typical example of how one builds abstract levels or systems of space-time in physics. In this case, „1 *mol*" is considered „1 *action potential*" of the macroscopic substance system, which is a U-set of N_A atoms or molecules; the latter are action potentials of the corresponding microscopic level (U-subset) of matter. All these abstract levels are built within mathematics and contain energy space-time as an element.

As we see, the definition of „mole" takes place within mathematics and results in a number - N_A. How can this abstract number be put in relation to matter (substance)? As usual, the principle of circulus viciosus is applied - a new unit of mass, the so called **atomic mass unit** *u*, is introduced. It corresponds to 1/12 of the mass of one carbon atom ^{12}C. In the new axiomatics, this circular definition employs N_A as a conversion factor and introduces the new unit of atomic mass *u* in relation to the standard unit of „1 *kg*":

$$u = 10^{-3}\ \text{kg}/N_A = 1.6606 \times 10^{-27}\ \text{kg}$$

$$1\ \text{u}/1\ \text{kg} = m_x/m_r = \text{SP(A)} = m = f = 1/10^3 \times N_A \qquad (46)$$

From equation (46), we obtain UE for the new quantity of reference „**molar mass**":

$$m_x\ [\text{kg}] = 10^3 m_r N_A\ [\text{mols}] = E_A\, f \qquad (46a)$$

Equation (46a) illustrates the „principle of similarity" - UE holds for space-time, as well as for any quantity thereof. As mass is a space-time relationship, this principle is cogent from the presentation of this quantity. From (46a) we can calculate the macroscopic molar mass of hydrogen M_H from the mass of *h* as a reference mass $m_r = m_p$. In this way we shall illustrate how one can obtain the mass of any macroscopic material object from the basic mass m_p of the „invisible" photon level, which physicists conventionally perceive as empty, massless space. For didactic purposes, we shall only consider the mass of the proton m_{pr}, and shall neglect the much smaller mass of the electron:

$$M_H = m_{pr} N_{\mathrm{A}} = (m_p f_{c,pr}) N_{\mathrm{A}} =$$

$$= 1.007 \times 10^{-3} \text{ kg/mol } (\cong 1 \text{ g/mol}) \qquad (46b),$$

where $f_{c,pr} = c/\lambda_{c,pr}$ is the Compton-frequency of proton and $\lambda_{c,pr} = 1.321410 \times 10^{-15}$ m is the Compton wavelength of this particle (see Table 1). It is a known natural constant. We conclude: it is possible to calculate the mass of any material object from the mass of the basic photon, that is, from the „mass of light". We owe this biblical achievement to the new axiomatics, which eliminates religion as a cosmological concept of genesis (see vol. IV).

1.10 MECHANICS OF SOLIDS AND FLUIDS

We finish our survey of classical mechanics with a description of **solids** and **fluids** as systems or levels of matter, which is a subset of space-time. We begin with the basic quantity „**density**". It is defined as a relationship of mass to volume (space) according to PCA:

$$\rho = \frac{m}{V} = \frac{K_s}{V} = \frac{\mathrm{SP(A)}[2d - space]}{[3d - space]} = \frac{\mathrm{SP(A)}}{[1d - space]} = \frac{\mathrm{SP(A)}}{[3d - space]} \quad (47),$$

when [2*d*-*space*] = SP(A) = 1 and m = SP(A). Density is a very popular quantity of space-time in physics. For this reason we use it in the universal equation of gravitation (41).

Solid objects are not as solid as their name would suggest: when subjected to forces (energy exchange), they tend to stretch, shear, or compress. Such interactions between solids give us an idea of the elastic continuum, as already described by the General continuum law, which represents the simplest differential form of the Law. This effect is much more pronounced in fluids. The quantities with which such interactions are conventionally described can be easily derived from the primary term. The pleonasm of force, called **stretching** or **tensile force,** leads to the introduction of **tensile stress**:

$$\sigma = \frac{F}{A} = \frac{\mathrm{SP(A)}\left[1d - space - time\right]f}{\left[2d - space\right]} = \frac{\mathrm{SP(A)}\, f^{2}}{\left[1d - space\right]} =$$

$$= \frac{\mathrm{SP(A)}}{\left[1d - space\right]} = \frac{m}{\left[1d - space\right]} \tag{48}$$

We obtain for tensile stress the same expression as for density (47). This part of mechanics is highly iterative. However, it is of great practical importance.

2. WAVE THEORY

2.1 OSCILLATIONS

Mechanics is predominantly a study of the statics and kinetics of solid material objects. At the same time it cannot neglect the objective existence of **oscillations** and **waves** that are propagated in solids, fluids, and gases. Oscillations and waves are a specific form of motion, which is the only manifestation of energy exchange. All motions in space-time are **superimposed rotations**, and any rotation can be regarded as a source of waves or oscillations. **Wave theory** consists of *harmonic synthesis* and *Furier analysis*, which are based on integral and differential calculus. Thus mathematics is the method of definition and measurement in wave theory. This is an invariant motif in all physical disciplines.

Major disciplines such as electromagnetism and quantum mechanics originate from wave theory. The distinction between waves and oscillations is of formal character - wave particles are said to „oscillate“ when they vibrate around a fixed point. When such oscillations are propagated in a medium, they are called waves. The two terms, „oscillation“ (transversal motion) and „wave“ (longitudinal motion), are subjective descriptions of real rotations. Both terms assess periodical events that can be described in terms of action potentials. For this reason, wave theory is basic to the presentation of action potentials (2.5). The basic method of wave theory is the **sinus-cosines function**, which is another mathematical expression of the probability set. This function is the method of definition and measurement of **simple harmonic motion**, which is an idealisation of real rotation - the source of simple harmonic motion is circular motion. Such motions can be described with Hooke’s law, that is an application of the Law.

A common quantity of oscillations is **frequency.** It is a particular quantity of time *f*. The SI unit of frequency is „1 *hertz*“, which is a synonym for „1 *action potential*“, e.g. 1 *second* (regarded as an event)

per unit of conventional time $t = 1$ s:

$$1\ hertz = 1\ second = 1\ E_A = 1\ \text{s}/1\ \text{s} = \text{SP(A)} =$$

$$= \text{certain event} = 1 \tag{49}$$

Wave theory acknowledges the fact that space-time has only two dimensions: the other quantity of importance is the **amplitude *A*** of an oscillation. It is defined as [1*d-space*]-quantity by the cosine function with respect to the „0"-point of the co-ordinate system:

$$x = A\cos\left(\omega t + \frac{3\pi}{2}\right) = A\sin\omega t = [1d - space]\,\text{SP(A)}\frac{f}{f} =$$

$$= \text{SP(A)}[1d - space] \tag{50}$$

The sinus-cosines function describes the space-time of rotations as a function of the amplitude - it is a magnitude of the maximal extent (distance) of an oscillation: $A = [1d\text{-}space]_{\max}$. The quantity ω in (50) is called **angular frequency** and is a pleonasm of angular velocity (17).

Wave theory produces a number of quantities, which are tautologies of those introduced in the mechanics of rotations (1.4). The distance *x* is a [1*d-space*]-quantity measured with respect to *A* (PCA) - hence SP(A) for the sinus-cosines function. The values of *x* „oscillate" between 1, 0, and –1. This mathematical-geometric function reflects the dynamic character of energy exchange as applied to its constituent *space*. The values of the continuous sinus-cosines function build the probability set $0 \le \text{SP(A)} \le 1$. Its mirror image (0,–1) is a pure convention, but it already anticipates the reciprocal character of space and time. The sinus-cosines function is a mathematical iteration of the continuum $n = \text{SP(A)}$. It illustrates the only possible method of acquiring the „certain event", namely, by comparing the space-time of a (rotating) system, or a quantity thereof (space *x*), with itself, e.g. with the amplitude *A*: $x_{\max}/A = 1$ (see also the SI unit *hertz* above). We shall show that the same mathematical approach leads to the definition of charge as a cross-sectional area of a wave or a particle (4.2).

Simple harmonic motion is regarded as a product of circular motion. The **energy** of this ideal rotation is assessed by Hooke's law:

$$E_{total} = U + E_{kin} = \frac{1}{2}kx^2 + \frac{1}{2}m\mathrm{v}^2 = \frac{1}{2}kx^2 =$$

$$= \mathrm{SP(A)}\, f^{\,2}\mathrm{SP(A)}\big[2d - space\big] = \mathrm{SP(A)}\big[2d - space - time\big] = E \quad (51)$$

We obtain UE for the energy of simple harmonic motion. As in classical mechanics, energy is subdivided in an abstract way into **potential energy** ($LRC = U$) and **kinetic energy** ($E_{kin} = E$). The **total energy** E_{total} is the sum of the two abstract U-subsets. This is a circumlocution of energy conservation due to the closed character of space-time. In the new axiomatics, we subsume this knowledge of the primary term under the axiom of CAP: when $E_{kin} = E_{A1}$ and $E_{pot} = LRC = U = E_{A2}$, then $E_{A1} = E_{A2}$. When E_{A1} is completely transformed into E_{A2}, we can assign the former the number „0“. In the theory of probabilities, this will be the „improbable event“ SP(A) = 0. In physics, this formal procedure is circumscribed as follows: „When the displacement is maximum $x = A$, the velocity is zero ($E_{kin} = 0$), and the total energy is: $E_{total} = 1/2k\, A^2 = E_{A2} = \mathrm{SP(A)} = 1$“[7]. The force constant k in equation (51) is a number $\mathrm{SP(A)}\, f^{\,2} = \mathrm{SP(A)}$ (7). In this case, the total energy in simple harmonic motion is proportional to the **square amplitude** A^2:

$$E_{total} = 1/2k\, A^2 = \mathrm{SP(A)}\, f^{\,2}[2d\text{-}space] = \mathrm{SP(A)}[2d\text{-}space] = K_s,$$

$$\text{when } f = \mathrm{SP(A)} = 1 \quad (52)$$

Equation (52) illustrates the classical method of mathematics, with which space-time (energy) E is reduced to space and described in terms of area or K_s. It is to this simple procedure that we owe the definition of charge Q as area: $Q = K_s = \mathrm{SP(A)} \times A^2 = cross\text{-}sectional\ area$ (see 4.2). The presentation of waves (oscillations) as energy E (51) or structural complexity K_s (52) is the vested prototype behind all basic definitions of electricity, electromagnetism, and quantum mechanics.

However, simple harmonic motion does not exist. It is an abstraction of our mathematical consciousness. This interaction is of the same paradigmatic character as „elastic collision“ or „closed conservative

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[7] PA Tipler, p. 377.

system“. Such ideas are N-subsets of consciousness that perceive the closed character of the primary term, but erroneously attribute this property to its open parts. In reality, all oscillations are **damped,** that is, they are **dissipative**. Consider now damping of oscillations as a drag force $F_d = -\,b\mathrm{v}$, where $b = \mathrm{SP(A)}\, f = mf$ is defined as a constant that describes the amount of damping. In fact, it is a mass quantity, that is, it is a space-time relationship $m_b = mf$ (1.8 and 1.9). The decrease of energy in damped oscillations is expressed with **exponential integrals** of the kind:

$$E = E_0 e^{-(b/m)t} = E_0 e^{-t/\tau} \tag{53},$$

where τ is the **time constant**:

$$\tau = \frac{m}{b} = \frac{m}{m_b} = \frac{\mathrm{SP(A)}}{\mathrm{SP(A)}_b} = \mathrm{SP(A)} = f \tag{53a}$$

Exponential integrals are mathematical iterations of the primary axiom that allow an infinite increase in mathematical complexity:

$$\frac{E}{E_0 e^{-(b/m)t}} = 1 = \textit{primary term} \tag{53b}$$

Equation (53b) confirms that we can add infinite quantities of the primary term to a mathematical equation without affecting PLE. This equivalence is the origin of all mathematical operations and equations, including exponential calculus. The time constant is a quantity of time $\tau = f$. This quantity determines the constant duration of each particular oscillation. We can regard an oscillation as a **standing wave** that can be described as a particle. In this case the time constant determines the lifetime of any system perceived as a structural complexity. From this we realize why exponential functions are frequently used in quantum physics for describing the finite lifetimes of particles, for instance, in radioactive decay.

When damped oscillations are driven, they behave like simple harmonic motion. **Driven oscillations** are open rotational systems. Recall: all gravitational systems, such as solar systems, are open rota-

tional systems (Kepler's laws). Each system has a natural frequency, called **resonance frequency** $\omega = \sqrt{k/m}\sqrt{\mathrm{SP(A)}\, f^2/\mathrm{SP(A)}} = f$ (53a). This term implies that each system has a specific, constant absolute time f (= resonance frequency) that determines its space-time and duration $t = 1/f$. Only when energy exchange occurs in a state of total harmony (resonance of frequencies) between the individual systems and levels do we have an optimal energy exchange leading to spatial stability of structures. This aspect is intuitively covered by the **factor of damping** ***Q*:** $Q = \omega_0/\omega = f_0/\Delta f = f = \mathrm{SP(A)}$.

The mathematical problem of determining the optimal conditions of energy exchange is to find Q, for which the maximal stability of forms is obtained. This is the eschatology of mathematics in the evolution of mankind - all natural sciences emerge as applications of mathematics for concrete levels of space-time, e.g. economics for the level of society, medicine and bio-sciences for the levels of cells and organisms. The only objective of these disciplines is to maintain harmony, and prolong the lifetime of K_s. In this sense, the KAM theorem may be an adequate approach to this problem.

2.2 MECHANICAL WAVES

Mechanical waves are oscillations of mass particles that are propagated in a medium. The medium is a system of matter that is usually described as „elastic". With respect to form, waves are subdivided into **transverse** and **longitudinal** waves. The basic quantity of waves is velocity as [1*d-space-time*]. There are various mathematical ways of expressing this universal quantity of energy exchange. A common formula is the building of a quotient (PCA) between the force F and the **mass per unit length** $\mu = m/\Delta s = \mathrm{SP(A)}/[1d\text{-}space]$; the latter quantity is a pleonasm of mass density (47):

$$v = \sqrt{\frac{F}{\mu}} = \sqrt{\frac{\mathrm{SP(A)}[1d - space - time]\, f\,[1d - space]}{\mathrm{SP(A)}}} =$$

$$= [1d\text{-}space\text{-}time] \qquad (54)$$

Equation (54) is another iteration of velocity within mathematics. From it, the classical wave function is derived (2.4). The calculation of harmonic waves leads to the introduction of further quantities (see also 1.4). The distance between two successive wave crests is called **wavelength** λ = [1*d-space*]. It is a constant for each system. For instance, the wavelength of a selected electromagnetic wave (system of photon space-time) that is emitted by caesium atoms is the original real reference system of the SI unit 1 *meter*, which is an anthropocentric surrogate. When this [1*d-space*]-quantity is set in relation to 2π, which is another [1*d-space*]-quantity, we obtain a new quantity, called the **wave number *k*,** which is a pure number. It is inconsistently expressed as reciprocal [1*d-space*]-quantity, because *pi* is erroneously considered a number and not a [1*d-space*]-quantity:

$$k = 2\pi/\lambda = \mathrm{SP(A)} \tag{55}$$

This quantity plays a central role in the presentation of standing waves (2.3). The primary term is considered in wave theory, insofar as this branch of physics cannot neglect the ample evidence that waves transmit energy. The equations that are derived for the energy of waves illustrate the infinite potential of mathematics in defining new quantities of the primary term, which are U-subsets thereof, and abide by the primary axiom:

$$\Delta E = \frac{1}{2}\mu\omega^2 A^2 \Delta x = \mathrm{SP(A)}\left[2d - space - time\right] \tag{56}$$

$$P = \frac{\Delta E}{dt} = \frac{1}{2}\mu\omega^2 A^2 \nu = \mathrm{SP(A)}\left[2d - space - time\right],$$

$$\text{when } P = E = E_A \tag{57}$$

Wave theory acknowledges that waves are U-subsets of space-time - it defines the **superposition** of harmonic waves as **interference**. „Superposition“ and „interference“ are synonyms. **Resonance** is another word for interference. Each superimposed wave can be regarded as a superimposed rotation. The **principle of superposition** of electromagnetism reflects the open character of the systems. Essentially, there are two forms

of interference, with which the boundary conditions of energy exchange are assessed: **constructive** and **destructive interference**. If the phase difference δ is zero, that is, if the waves are in phase, the resultant wave has an amplitude twice that of either wave. This is the mathematical condition for constructive interference: $y_1 + y_2 = 2A \sin(kx - \omega t)$, $\delta = 0$. When the phase difference is $\delta = \pi\text{rad} = 180^o$, the waves are out of phase: $y_1 + y_2 = A \sin(kx - \omega t) - A \sin(kx - \omega t) = 0$. This is the mathematical condition for destructive interference. We may also say that this is the condition under which structural complexity dissipates, or space disappears.

The space of the resultant system from the interference (interaction) of two waves with a given amplitude (AR) dissipates in the space-time of the underlying systems. We can describe constructive interference as „harmony“ or „order“ and destructive interference as „disharmony“ or „disorder“ (chaos). These terms are of precise mathematical character. They are consistent with the basic axioms of our axiomatics.

Although **acoustics** is a separate branch of physics that deals with **sound**, sound waves are mechanical waves. Everything we have already said about mechanical waves also holds in the case of sound.

2.3 STANDING WAVES AND QUANTUM MECHANICS

When waves are confined in space like waves on a guitar string, there are reflections at both ends so that the waves are travelling in both directions. Under the condition of constructive interference, a stationary vibration pattern occurs, called a **standing wave.** It can be described in terms of a fundamental mode of vibration (first harmonic), second, or *n*th-harmonic, which are circumlocutions for the number of action potentials $f = n$. The point of maximal amplitude is called antinode ($A = [1d\text{-}space]_{max}$) and the midpoint - node ($x = [1d\text{-}space]_{min}$). This is pure geometry applied to the physical world. The space confinement of the string at both ends embodies the closed character of space-time. The **standing wave condition** is usually defined for the space, for instance, for the length of the string:

$$l = n\frac{\lambda_n}{2} \text{ , when } n = f = 1,2,3,... \tag{58}$$

The length of the string can be regarded as the circumference of a circle $l = C$. From equation (58), one can find the frequency of the nth harmonic:

$$f_n = n\frac{v}{2l} = \frac{n}{2l}\sqrt{\frac{F}{\mu}} = nf_1 = ff_1 = f_n = \text{SP(A)}, n = f \tag{59}$$

Equation (59) reveals that standing waves are U-subsets that contain themselves as an element. Each standing wave is the aggregated product of superimposed waves. It can be expressed as the resultant wave of two interacting waves $f_n = ff_1$ (AR). The frequency of a standing wave is a function of the driving force F and the mass (space-time relationship) μ of the system. This confirms that standing waves are propagating energy. In this case, the first harmonic or fundamental can be regarded as the elementary action potential of the vibrating system. Standing waves can be counted. The same is true for the action potentials $n = f$. Wave theory uses only integers to count nth-harmonics. This approach reflects the preferential use of integers in mathematics and in calculation. In reality, $f = \text{SP(A)} = n$ is always a transcendental number. This becomes evident when we consider l as a circumference C. We can measure the latter only when we use the transcendental number *pi*.

A standing wave is thus a U-subset of space-time that manifests the properties of the primary term. In this sense, if we consider space-time as a closed entity that is confined to itself, we can regard it as the **total set of all superimposed waves** (U-subsets), which are rotating in both directions. They build various standing waves that are distinct systems or levels of space-time. Such standing waves are conventionally called elementary particles, atoms, molecules, macroscopic matter, solar systems, galaxies, etc.

We have proved that all motions in space-time are superimposed rotations because of the closed character of space-time (U-subsets). Linear translation is a pure abstraction born in the realm of geometry. On the other hand, we learn from wave theory that any real rotation is a source of waves.

In electromagnetism, photon space-time is described in terms of electromagnetic waves that are rotating. On many occasions (e.g. in QED), electromagnetic waves are regarded as particles: one speaks of standing waves or **wave packets** (2.5) that propagate energy in the form of action potentials throughout space with the constant speed of *c*. This approach is basic to Planck's equation $E = hf = hc/\lambda = E_A\, f$, with which the ultraviolet catastrophe in **Rayleigh-Jeans law** has been eliminated. Quantum mechanics describes all elementary particles by giving their **spin** or **angular momentum,** which are quantities of rotation.

Indeed, equation (59) tells us that the term „standing wave" implicates the propagation of discrete amounts of energy with the velocity v that is specific for each vibrating system. The term „standing" is thus restricted to the visual form. In reality, all particles of a vibrating system which builds a standing wave are in incessant motion. The General continuum law and the classical wave equation (2.4) cover this issue. From this simple introduction we can conclude that:

> The term „**particle**" is a circumlocution for the **standing wave condition** (*constructive interference*) that allows the building of standing waves or wave packets (2.5) of varying form, space, time, and velocity.

This conclusion effects a great simplification in our physical outlook, especially in quantum mechanics. For instance, de Broglie interprets **Bohr's quantization condition** for the angular momentum (24) $L = m\mathsf{v}r = E_A = nh/2\pi$ of the electron of the hydrogen atom (Bohr's 3. postulate, see 5.1) as a „**standing photon wave in rotation**". In this case, the momentum $m\mathsf{v}$ is substituted with the term h/λ to obtain the circumference of **Bohr orbit** (electron orbit) $C = l = n\lambda = 2\pi r$. The photon wave rotating along this circumference can be a standing wave, called electron, only if it complies with the standing wave condition (constructive interference) in equation (58): $C = n\lambda/2 = \pi r$. In fact, this conventional approach of Bohr and de Broglie is a hidden definition of the axiom of CAP: $E_{A,electron} = m_e c\lambda_{c,e} = h = m_p c\lambda_A$ (45a). With this equation, we can find the exact wave frequency of constructive interference of the electron that allows its existence as a **standing photon wave in rotation.** In the view of wave-particle dualism, this condition is considered a „particle**"**:

$$f = \frac{c}{\lambda} = n\frac{c}{2C} = f_n \frac{[1d - space - time]}{2[1d - space]} = f_n f_c \qquad (60)$$

According to equation (60), the frequency of the electron wave can be expressed as a resultant frequency of two superimposed waves (AR). A full elaboration of the Bohr model is given in 5.1.

Much of wave theory is dedicated to wave forms. When they are analysed with respect to the harmonics that comprise them, this is called **harmonic analysis** or **Furier analysis** (to be compared with mathematical analysis, e.g. with differential calculus). The inverse of harmonic analysis is called **harmonic synthesis** (to be compared with integral calculus). Both branches introduce mathematics as the only method of definition and measurement in wave theory. Their origin is the primary term - such mathematical operations adequately reflect the inhomogeneous character of space-time as the total set of U-subsets - in this particular case, as superimposed rotations that contain themselves as an element.

2.4 WAVE EQUATION

The general wave function $y\,(x,t)$ is a solution of a differential equation, called **wave function**. This equation is a derivation from the General continuum law, which is a differential equation of UE. In this chapter, we shall prove that the **classical wave equation** is an application of the Law. As the wave function is also basic to Schrödinger wave equation of quantum mechanics, we shall actually prove that both macrocosm and microcosm are adequately described with UE.

The derivation of the wave function departs from the notion that all particles participating in a wave perform a rotation that approximates *circular motion*. This motion is then described by Newton's laws. Equation (54) gives the method of derivation, which results in the following differential equation:

$$\frac{\partial^2 y}{\partial x^2} = \frac{\mu}{F}\frac{\partial^2 y}{\partial t^2} = \frac{1}{v^2}\frac{\partial^2 y}{\partial t^2} = \frac{1}{[2d - space - time]}\frac{\partial^2 y}{\partial t^2} = \frac{1}{LRC}\frac{\partial^2 y}{\partial t^2} \qquad (61),$$

where $x,y = [1d\text{-}space]$ and $t = 1/f$; y is the amplitude and x is the segment length in the direction of the wave length. This is the differential form of the **wave equation**. If we solve for the *LRC*, we acquire UE:

$$LRC = \frac{\partial x^2}{\partial t^2} = \partial x^2 \partial f^2 = \mathrm{SP(A)}[2d - space - time] =$$

$$= [2d - space - time] \qquad (62),$$

when $\partial = \mathrm{SP(A)} = 1$. The wave function demonstrates that UE is the origin of all mathematical operations - in this particular case, of differential calculus. This helps to understand Nabla and Laplace operators (4.6), which are basic to Maxwell's equations (4.13). We have proved that the classical wave function is a concrete application of UE. In the next chapter, we shall show that each wave or oscillation can be presented as an action potential E_A. Thus we shall ultimately prove the **wave character** of space-time.

2.5 THE ACTION POTENTIAL AS A WAVE

Regardless of the actual form, each **action potential** can be described as a **wave**. According to wave-particle dualism in physics, it can be visualized as an oscillation that repeats itself, e.g. as a wave that moves along a string, or as a standing wave. Both moving and standing waves are assessed as events in motion and described by the velocity (54) or $LRC = \mathrm{v}^2$ (62). As space-time has only two constituents, a wave is usually described in terms of space and time. For instance, the wave equation (61) is a differential function y with respect to space $x = [1d\text{-}space]$ and time $f = 1/t$. The basic property of the action potential is its constant space-time (energy). The amount of energy is specific for each system or level. This constancy also holds in space and time. For example, Compton wavelength and frequency of the elementary particles electron, proton, and neutron are well known natural constants.

Consider now a standing wave on a string: the first harmonic which we call the **elementary action potential** of the system has the same amplitude A as the nth-harmonic of the standing wave. In any vibrating system, the amplitude A of a simple harmonic motion is constant for

each *n*th-harmonic, that is, it is independent of the actual frequency. Note: In this case, we can arbitrarily regard each *n*th-harmonic as a distinct system with a specific constant frequency and form, although it occurs on the same string. The total energy of a simple harmonic wave depends only on the square amplitude $E_{total} = 1/2kA^2 = \text{SP(A)}[2d\text{-}space\text{-}time]$ (51), because the force constant *k* of Hooke's law is specific for each system; *k* is square time $k = \text{SP(A)}\, f^2 = f^2$(7). It assesses the specific time of the system as a resultant quantity of two superimposed waves (AR).

The formula for the total energy of a simple harmonic wave (52) proves the axiomatic definition of the constant space-time of E_A. As space-time of waves is assessed in terms of wavelength and frequency, these quantities are also found to be constant for each system (source and medium). The same is true for the velocity - it is a specific constant for each medium (system). When *k* is expressed as a closed number that belongs to the continuum $k = \text{SP(A)}f^2 = n$, the UE of a wave energy is presented as K_s:

$$E_{total} = \text{SP(A)}[2d\text{-}space\text{-}time] = 1/2kA^2 =$$

$$= \text{SP(A)}[2d\text{-}space] = K_s \qquad (63)$$

Within mathematical formalism, we can voluntarily set the term $1/2k = \text{SP(A)}\, f^2 = 1$ for the certain event or for 1 *unit*. We find that the **total energy** of a reference wave is equivalent to the **square amplitude** $\boldsymbol{A}^2$:

$$E_{total} = K_s = A^2 \qquad (63a)$$

This is a very useful equation that demonstrates how the elementary charge of the electron is defined within mathematics (see 4.2). In this case, the particle „electron" is regarded as a reference system of area. Within mathematics, we can describe the space-time of waves as energy exchange *E* or structural complexity K_s (particle). The latter quantity is usually presented as a **cross section to the direction of motion.** For instance, the antinode of a standing wave on a string can be presented as a cross section (*square amplitude* = A^2), while a standing wave in rotation, which is visualized as a sphere, is usually given as a disc or area of hemisphere. This geometric approach is used in the presentation of the electron ((4.2);

see also Coulomb's law above).

Thus physics is to a large extent applied geometry - this is the hidden definition of this discipline. However, geometry is an idealisation of the real world - all geometric forms are defined through exact equivalencies of abstract character. For instance, the circle is defined as the line that displays the same distance from a point, called a „centre", to any point of the line, called „circumference". In reality, all equivalencies which we define are mathematical approximations - they are abstract definitions of the mind based on the primary idea of closed real numbers, e.g. SI system. As mathematics has not yet developed an adequate method of using transcendental numbers, we also resort to closed real numbers in this book. However, the only correct perception of space-time is the use of transcendental numbers. It is very important not to forget this fact.

A classical example of an action potential in wave theory is the **wave packet**. The presentation of this energetic event demonstrates the use of the closed real number „1" as the ubiquitous symbol of the primary term, or a subset thereof. The wave packet is a pulse consisting of a group of waves of different frequencies that has a beginning and an end, whereas a harmonic wave repeats itself again and again. When the range of the angular frequencies $\Delta\omega$ is very large $\Delta\omega \rightarrow \infty$, the duration of the pulse is very short $\Delta t \rightarrow 0$. In wave theory, the general relation between these two quantities of the wave packet is set equivalent to the number „1":

$$\Delta\omega\Delta t = 1 \tag{64}$$

This equation merely reflects the reciprocal character of space and time $\Delta\omega = 1/\Delta t = f$. The reciprocity of the two constituents becomes evident when the *wave number k* is introduced $\Delta k = \Delta\omega/\mathrm{v} = 1/[1d\text{-}space]$ (55). Equation (64) can then be rearranged as follows:

$$\mathrm{v}\Delta k\Delta t = \Delta k\Delta x = [1d\text{-}space\text{-}time]/[1d\text{-}space]\ f = 1 \tag{65}$$

This formula illustrates the principal way of building mathematical equations. One can introduce an infinite number of quantities of space-time as U-subsets and set them equivalent to the universal mathematical symbol „1" of the primary term according to PLE. In addition, our mathematical consciousness has the degree of freedom to attribute this

number to any subset of space-time, for instance, to an action potential or a system as 1 *unit* or the certain event. From this we follow:

> The number „1“ is the universal symbol used for the building of all mathematical equations, independently of the kind of operations employed.

For example, Schrödinger has used the same procedure to establish his wave equation of quantum mechanics. In the **standardisation condition** („Normierungsbedingung“) of his wave function ψ, the **probability density** of the particle is statically regarded as an area integral, that is, as K_s, and is set equivalent to the number „1“ in an *a priori* manner without any physical foundation $\int_{-\infty}^{+\infty} \psi|(x)|^2 \, dx = 1$. Although it is generally acknowledged that this equation cannot be explained in real terms, until now nobody has ever had the idea of solving this fundamental epistemological problem of quantum mechanics with the philosophical and cognitive background of meta-mathematics, as is done in the new axiomatics. This proves that physics is mathematics applied to the real physical world.

2.6 THE DOPPLER EFFECT

This survey on wave theory would be incomplete without discussing the **doppler effect**. We observe this universal phenomenon in all kinds of waves because it **is a manifestation of the reciprocal character of space and time**. Since matter and photon space-time are of wave character, the doppler effect is the universal verification of this fundamental property of the primary term. The doppler effect is fairly simple to understand: when a wave source and a receiver are moving relatively to each other, the frequency observed by the receiver is not the same as that of the source. When they are moving towards each other, the observed frequency is greater than the source frequency; when they are moving away from each other, the observed frequency is less than the source frequency. This is the essence of the doppler effect. What is the interpretation of the doppler effect in the light of the Law?

Let us consider the medium that is confined by the wave source and the receiver as a distinct system of **constant** space-time. For didactic purposes, we choose an electromagnetic wave, that is, we have a system of photon space-time, although our elaboration holds in any other medium. The space-time of the photon system is determined by the distance between the wave source and the receiver which is [1*d-space*]-quantity.

As long as the wave source and the receiver are not moving, the space of the photon system as measured by the distance is constant. In this case, the space-time of the system is also constant. This is also true for the time of the photon system, which is the complementary constituent to space. Indeed, the observed frequency is constant when the distance to the receiver remains constant.

When the wave source and the receiver are moving towards each other, the space of the photon system decreases. In this case, it is irrelevant which one of them is responsible for this relative change of distance. As the space-time of the photon system that is confined by the wave source and the receiver is constant, the time of this system should increase in a reciprocal manner.

This relative change is observed by the receiver as an increase in the frequency of the emitted electromagnetic wave: when [1*d-space*] $\rightarrow 0$, then $f \rightarrow \infty$, because $f = 1/[1d\text{-}space]$. When this phenomenon is observed with visible light, the relative change in frequency is called **violetshift**.

The distance between the wave source and the receiver increases when they are moving away from each other. In this case, the space of the photon system increases and its time decreases in a reciprocal manner: when [1*d-space*] $\rightarrow \infty$, then $f \rightarrow 0$, because $[1d\text{-}space] = 1/f$. This change in the frequency is called **redshift**.

As we see, the reciprocity of space and time that is assessed by the doppler effect can be adequately expressed with the number „1“. The doppler effect is usually summarized by the following equation:

$$f' = \frac{(1 \pm u_r / \mathrm{v})}{(1 \pm u_s / \mathrm{v})} f_0 = \mathrm{SP(A)} f_0 \qquad (66),$$

where u_r is the speed of the receiver relative to the space-time of the photon system (medium) and u_s is the speed of the source relative to the

space-time of the photon system. Equation (66) says that the relative change in wave frequency $f'/f_0 = \mathrm{SP(A)} = time$ is a number belonging to the continuum $n = \mathrm{SP(A)}$. This is the essence of physics and mathematics: all we can do in these disciplines is to build relationships between [1*d-space*]-, *f*-, or [n*d-space-time*]-quantities of selected systems of space-time and obtain dimensionless numbers belonging to the continuum *n*.

The doppler effect is basic to the new explanation of gravitation. We shall not discuss this key aspect of the new theory in the present concise version of volume II.

3. THERMODYNAMICS

3.1 WHAT IS TEMPERATURE ?

Thermodynamics studies temperature, heat, and the exchange of energy. This branch has the same universal role in physics as wave theory. The basic quantity of space-time in thermodynamics is **temperature *T***. It is as familiar to us as conventional time. Precisely for this reason, though, temperature has not been understood. Temperature is defined by a change in space. In thermodynamics this change is measured three-dimensionally as volume [3*d-space*]:

$$T = f = [3d\text{-}space]_x \,/\, [3d\text{-}space]_R = f_R \,/\, f_x = \mathrm{SP(A)} \qquad (67)$$

As with all other quantities, the method of definition of temperature is at the same time its method of measurement. It is based on **thermal contact** (continuousness of space-time). The measurement of *T* takes place in **thermal equilibrium,** also known as the **zeroth law of thermodynamics.** This says that if two objects are in thermal equilibrium with a third (through contact), they are in thermal equilibrium with each other. This is an intuitive notion of the primary term as a continuum. This law anticipates the existence of a common thermodynamic level of space-time, which is part of all material objects (U-subset of matter). The absolute time of this level is constant $T = cons.$ because its space-time is also constant. All basic ideas in physics are intuitive perceptions of the nature of the primary term.

Thermal contact and equilibrium are the real prerequisites for the definition and measurement of *T*. According to PCA, one needs a reference system to make a comparison. The choice of the reference system to which the temperature of the objects is compared has evolved with time. The mercury column of the normal thermometer is such a reference system. From a theoretical point of view, the choice of the substance is of no importance - mercury can be substituted by any other substance. The

choice of the geometric shape of the mercury column is, however, not accidental. It is a cylinder with the same cross-section along the whole length of the scale, so that equivalent changes of the mercury volume lead to equivalent changes of the column length: $\Delta[3d\text{-}space] \cong \Delta[1d\text{-}space]$. Thus, the building of equivalent increments of mercury volume, which can be regarded as constant action potentials E_A, is the *a priori* condition for the measurement of temperature.

Once the building of real space equivalencies is ensured by applied geometry, mathematics is subsequently introduced as the method of measurement. The normal **freezing point** of water (ice-point *T*) has been assigned the number „0“, the normal **boiling point** of water (steam-point *T*) the number „100“. The unit of volume change is arbitrarily called „degree“ and is written as 0°C or 100°C. “C“ stands for Celsius, who was the first to introduce this scale - hence **Celsius temperature scale**. The length of the mercury column at 0°C is L_0 and at 100°C it is L_{100}. The length difference $\Delta L = L_{100} - L_0$ is subdivided evenly into 100 segments, so that each length segment corresponds to „1 *degree*“. The number „100“ for ΔL is voluntarily selected. Within mathematics, we can assign this magnitude any other number, for instance “1“, without affecting the actual measurement of temperature. The number “100“ of the Celsius scale is a simple conversion factor $K = \mathrm{SP(A)}$ of space measurement. This becomes evident when we compare the Celsius scale with the Fahrenheit temperature scale. Celsius temperature t_c is defined as:

$$t_C = \frac{L_t - L_0}{L_{100} - L_0} \times 100° = \frac{\Delta L_x}{\Delta L_R} = \frac{[1d - space]_x}{[1d - space]_R} = \frac{f_R}{f_x} = f = \mathrm{SP(A)} \quad (67a)$$

or

$$[1d - space]_x f_x = [1d - space]_R f_R = \mathsf{v}_x = \mathsf{v}_R =$$

$$= [1d - space - time]_{thermal} = constant \quad (67b)$$

Equation (67b) proves that „thermal equilibrium“ is a tautology of the constant space-time of the **thermodynamic level of matter.** However, the actual space and time (temperature) magnitudes are specific for each substance or object that can be regarded as a distinct thermal system - hence the necessity of measuring its particular temperature and volume. The same holds true for their relativistic changes.

Mercury thermometers are not very precise. Because of the difficulties in duplicating the ice-point and steam-point states with high precision in different laboratories, a temperature scale based on a single fixed point was adopted in 1954 - the **triple point of water**. This equilibrium state occurs at a pressure of 4.58 mmHg and a temperature of 0.01°C. The ideal-gas temperature scale is defined so that the temperature of the triple point is $T = 273.16$ kelvins (K), where „degree kelvin“ is a unit of the same size as the Celsius degree. The number 273.16 is thus a conversion factor ($T = t_c + 273.16$). In 1990, a new fixed point for the Kelvin scale was introduced based on 17 calibrating points (minimisation of systemic failure). This is not the end of the story. With the discovery of the Law, it will be possible to define a new, more precise temperature scale that will be based on photon space time as a reference system. The scientific foundation of such a scale is based on the knowledge that temperature is a quantity of time (see also Stankov's law in 3.7).

3.2 THE IDEAL-GAS LAWS

The **ideal-gas laws** are concrete applications of the Law for the **gas level** (U-subset of matter) that lead to the derivation of **Boltzmann's law**. The latter is the generalized form of the Law for the **thermodynamic, kinetic level** of matter. These laws are based on PCA: if we compress gas, that is, if we exert a force F on it, while keeping the temperature constant $T = f = cons.$ (building of equivalence), we find that the **pressure** increases as the volume decreases (comparison). Similarly, if we cause a gas to expand at constant temperature, its pressure decreases as its volume increases:

$$P = F/A = \text{SP(A)}[1d\text{-}space\text{-}time]\, f\, /\, [2d\text{-}space] =$$

$$= \text{SP(A)}\, f^{\,2}/[1d\text{-}space] \qquad (68)$$

In this case, pressure is an abstract quantity of space-time; it is of the same character as tensile stress (48) or density (47). When pressure is exerted on gases or other contractible materials, their density increases and vice versa. This quantity reflects the reciprocal character of space and time. We have shown that the quantity density is proportional to the amount of energy, which is reciprocal to space. This is confirmed by

equation (68) - the density is reciprocal to space. This fundamental property of space-time was first discovered by Robert Boyle (1662) and, independently from him, by Edme Mariotte (1676), and is known as **Boyle-Mariotte's law**:

$$PV = \frac{\mathrm{SP(A)}\, f^{2}[3d - space]}{[1d - space]} = \mathrm{SP(A)}[2d - space - time] =$$

$$= E = constant \tag{69}$$

It says that the space-time of the gas level is constant at constant temperature: $E \approx T = f = cons.$ (constancy of space-time as manifested by the parts). **Boyle-Mariotte's law** is one of the oldest mathematical derivations of the Law obtained for a distinct level of space-time. Its subsequent implementation in practice has led to the development of **steam-engines**, with which the industrial era commenced. This was a breakthrough in the evolution of mankind. It gives us an idea of the scale of the industrial revolution that will occur in the next millennium when the Law is broadly comprehended and applied to different levels of space-time.

Boyle-Mariotte's law is a linear relationship between space-time and space at low densities. When the density is very high, new levels of matter (space-time) are created that exhibit a different linear relationship - that is, when we increase or decrease space significantly, we obtain different levels of space-time, which are **inhomogeneous.** The energy-space relationships of such levels are **scale-variant** - they are specific for each level. At present, most laws, such as Newton's law of gravity, are considered scale-invariant, although this is already doubted[8]. Scale-invariance is an abstract idea born within mathematics - it stems from the assumption of homogeneous empty space (vacuum) - and should be rejected on purely theoretical grounds. For instance, the scale-invariance between space-time and space or time only holds in „ideal-gas", which is an abstract idea of the mind. It is a closed system, just like elastic colli-

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[8] P.G. Bizzeti et al. Search for a composition-dependent fifth force. Phys. Rev. Letters, Vol. 62, No. 25, 1989, p. 2901-2904; C. Jekeli et al. Tower gravity experiment: No evidence for a Non-Newtonian gravity, Phys. Rev. Letters, Vol. 64, No. 11, 1990, p. 1204-1206, etc.

sion or blackbody radiation. Another precursor of the ideal-gas law is the so-called **Gay-Lussac's law**:

$$PV = CT = \text{SP(A)}[2d\text{-}space\text{-}time] = E_A f,$$

$$\text{where } C = E_A \tag{70}$$

C is a **constant of proportionality** appropriate to a particular system of gas. It represents an action potential that is a specific constant amount of energy for each particular gas system. In thermodynamics, this quantity is given with respect to Avogadro's number N_A and Boltzmann's constant k_b. The latter is fundamental to Boltzmann's law:

$$C = k_b n N_A = k_b N \tag{71}$$

As Avogadro's number is a quantity of time $N_A = f = \text{SP(A)}$ ((46a) & (46b)), **Boltzmann's constant** is an action potential, which is obtained within mathematics when the Law is applied as an RT:

$$\frac{C}{k_b} = \frac{E_{macro}}{E_{micro}} = \frac{E_{A(macro)}}{E_{A(micro)}} = nN_A = f = \text{SP(A)} \tag{71a}$$

Equation (71a) shows that Boltzmann's constant is an action potential of the microscopic molecular level, while Avogadro's number is the time of the corresponding macroscopic **mol-level** $N_A = f_{mol}$ (see 1.9). We can now rewrite equation (71):

$$C = k_b n N_A = E_A f_n f_{mol} = E_A f = E_A ,$$

$$\text{when } f_n f_{mol} = f = \text{SP(A)} = 1 \tag{71b}$$

Equation (71b) illustrates the universal mathematical procedure for creating new quantities and terms in physics. One can always define the space-time or a quantity of the infinite underlying levels of a system as the certain event SP(A) = 1 or, alternatively, as 1 *unit* and compare the space-time of the other levels or systems with it. From (71) to (71b), we obtain the **ideal-gas law** as an application of the Law:

$$PV = nN_A\, k_bT = nRT = E_A\, f_n\, f_{mol}\, f_T = E_A\, f = E,$$

$$\text{when } f = f_n\, f_{mol}\, f_T \qquad (72),$$

where $R = k_bN_A = E_A\, f$ is the **universal gas constant**. Its value is the same for all gases - R assesses the constant space-time of the gas mol-level. Alternatively, it can be expressed as an action potential $C = Rn = E_A\, f$ (degree of mathematical freedom).

3.3 BOLTZMANN'S LAW AND THE KINETIC THEORY OF GASES

The interpretation of the ideal-gas law from the point of view of classical mechanics is called the **kinetic theory of gases**. It reflects the basic axioms of the new theory. At the same time, the kinetic theory of gases exhibits the principal flaws in the outlook of conventional physics. Microscopically, the pressure of a gas is explained as the result of „elastic collisions" between the gas molecules and the wall of the container. The latter represents a contiguous level of vertical energy exchange. The pressure is calculated by the rate of change in momentum of the gas molecules due to collisions with the wall of the container. By Newton's second law, the force exerted by the wall on the gas molecules is $F = dp/dt$. By Newton's third law, this force equals the force exerted by the molecules on the wall, while the force per unit area (geometry) equals the gas pressure (CAP). This simple mechanistic view of the microcosm is based on several assumptions of abstract character: a) The molecules make elastic collisions with each other and with the wall (closed systems); b) The molecules are tiny particles that are separated, on average, by distances which are large when compared with their diameters. They exert no forces on each other except when they collide (assumption of vacuum as an N-set that contains the microscopic systems of space-time as mass points); c) In the absence of external systems, there is no preferred position for a molecule in the container, and there is no preferred direction for the velocity vector.

This is an application of PCA for the microcosm that is analogous with the cosmological principle for the macrocosm. It is assumed that the molecules are moving fast enough to neglect gravity. As velocity is the universal quantity of energy exchange, this would mean that the en-

ergy of the thermodynamic, kinetic level is much greater than the energy of the gravitational level of matter. This allows the elimination of gravitational space-time by mathematical abstraction. As the **average kinetic energy of the molecules K_{av}** is much greater than gravitation E_G, that is, E_G/K_{av} approaches zero, we might as well assume that gravitation also approaches zero $E_G \rightarrow 0$ when compared to K_{av}. Therefore, the assumptions of the kinetic theory of gases hold only in ideal gas that is free of gravitation. It is regarded as being composed of „elastic mass particles without space". Thus the concept of „ideal gas" is a geometric abstraction. When the ideal-gas law is solved with respect to v_{av} within geometry, we obtain **Boltzmann's law** of the **average kinetic energy** for the thermodynamic level:

$$K_{av} = (1/2mv^2)_{av} = 3/2k_bT = 3/2(R/N_A)T = E_{micro} = E_A f \qquad (73)$$

$$K_{av} = N(1/2mv^2)_{av} = 3/2Nk_bT = 3/2nRT = E_{macro} = E_A f \qquad (73a)$$

Equation (73) considers the kinetic energy of translation per one molecule of gas (molecular level), while equation (73a) describes the kinetic energy per *mol* substance (mol-level). **Boltzmann's constant** k_b is the **constant action potential** of the **kinetic molecular level**. The quotient 3/2 = SP(A) results from the geometric method of derivation. Boltzmann's law is based on the primary idea of the average velocity of molecules, which, according to PCA, is the only method of definition of a level. The kinetic action potentials of the molecules, which are considered in an *a priori* manner equal in the mean, build an abstract thermodynamic level of constant space-time in motion - K_{av}. Only when this equivalence is assumed can we define various systems and levels of matter, for instance, *n-mol*-systems. Therefore, the thermodynamic, kinetic level is an abstract mathematical definition.

Boltzmann's law can be expressed as a **statistical function** of velocity within mathematics. The so-called **Maxwell-Boltzmann energy distribution function** is the first major application of the theory of probabilities in physics. It recognizes that the space-time of a level is an **assembly** (U-set) of discrete energetic events. This is an anticipation of the inhomogeneous character of the primary term as it is set forward in quantum mechanics (section 5.). At the same time, it illustrates the intrinsic propensity of mathematics to evolve into a symbolic system of infinite complexity:

$$F(E_{kin}) = \frac{2}{\sqrt{\pi}}\left(\frac{1}{k_b T}\right)^{3/2} E_{kin}^{1/2} e^{-E_{kin}/k_b T} = K_{av} = E_A f \qquad (74)$$

Boltzmann's law is highly esteemed in physics because of its degree of abstraction - it proves that the kinetic thermodynamic energy of matter depends only on temperature, which is a quantity of time for this level $E \approx T = f$. Alternatively, the space-time of this level can be expressed as a function of the mean velocity, also called **root mean square speed** $\mathbf{v}_{rms}$:

$$f(\mathrm{v}) = \frac{4}{\sqrt{\pi}}\left(\frac{m}{2k_b T}\right)^{3/2} \mathrm{v}^2 e^{-m\mathrm{v}^2/2k_b T} = [1d - space - time] \qquad (74a)$$

Velocity is the universal quantity of energy exchange that manifests itself as motion. Any level has a specific constant velocity: while the photon level has the constant speed of light *c*, the thermodynamic level of matter has the constant speed of v_{rms} (see also the **constant** *B* of Wien's displacement law in 3.5).

3.4 HEAT AND THE FIRST LAW OF THERMODYNAMICS (ND)

„**Heat** is energy that is transferred from one object to another because of a difference in temperature."[9]. Thermodynamics considers heat as a specific level of energy exchange. It began as a **caloric theory**: heat was regarded as an invisible fluid, called „caloric", that was neither created nor destroyed, but merely flowed as a conserved material substance from one material object into another. The intuitive notion of energy (space-time) was projected on heat, which is a level thereof. The flaw in the caloric theory is that it considers heat a closed entity which does not participate in an energy exchange with other levels. The modern **mechanical theory** considers **thermal energy** (= heat) as the „internal energy" of a system. In its view, heat energy is transferred from one object to

[9] PA Tipler, p. 517.

another because of the difference in temperature $\Delta T = \Delta f = \mathrm{SP(A)}$. The **first law of thermodynamics** is a law of conservation of energy - although it is rooted in basic inconsistencies, it is still the most adequate perception of the Law that has been developed so far.

The basic terms, „heat", „thermal energy", „internal energy", and „thermodynamic, kinetic energy", are confused in current thermodynamics. „Heat" and „thermal energy" are used as synonyms. „Internal energy" is a synonym for the kinetic energy of the thermodynamic level, which is assessed by Boltzmann's law (73a). „Heat" is the amount of thermodynamic, kinetic energy that is exchanged between two objects or within an object when there is a difference in temperature. The metaphysical character of the thermodynamic level makes heat an adequate paradigm of energy exchange at the level of matter. This is the **substantial** view of classical physics.

Heat energy Q (should not be confused with charge Q, ambiguity of physical symbolism) is defined as the amount of exchanged energy that is needed to raise the temperature of a substance $Q \approx T = E \approx f$. When we build a quotient of space-time and time according to PCA, we obtain the action potential $Q/T = C = E/f = E_A$, or $C = E_A$. This is an application of UE. The new quantity C is called **heat capacity**. It is defined as the amount of heat energy needed to raise the temperature of a substance by one degree: if $T = f = \mathrm{SP(A)} = 1$, then $C = E_A\, f = E_A$. We come across the universal procedure of building new quantities of space-time by employing the number „1" as the universal symbol of space-time or a quantity thereof. In a vicious circle, another basic quantity is obtained - the **specific heat** ***c***. It is defined as the heat capacity per unit mass $c = C/m = C/K_s = E_A/K_s = \mathrm{SP(A)} = f$, or $C/c = m = \mathrm{SP(A)}$. By employing these quantities, the space-time of heat is expressed as follows:

$$Q = C\Delta T = mc\Delta T = E = E_A\, f \tag{75}$$

This equation is equivalent to Boltzmann's law and is another application of UE. The historical unit of heat energy is the **calorie**. It is arbitrarily defined as the amount of heat needed to raise the temperature of one gram of water one Celsius degree. This definition demonstrates the validity of the basic statements of our axiomatics. We can voluntarily select the energy of a real system $Q = C\Delta T = E_A\, f$ and assign it the number „1" by defining its time $\Delta T = f = \mathrm{SP(A)} = 1$ as the certain event or 1 *unit*: $Q = C = E_A = 1$ *calorie*. The term „1 *calorie*" is a synonym for the en-

ergy of an arbitrarily chosen thermal system that is regarded as a constant action potential. It can be substituted by any other action potential by employing a conversion factor, for instance, by the SI unit 1 *joule* = = 1 *calorie*/4.184 or 1 *joule*/1 *calorie* = E_{AJoule}/E_{Acal} = SP(A) = 1/4.184. The measurement of energy in terms of the SI unit „1 *joule*" is an intuitive perception of the fact that space-time is inhomogeneous. When we say that the energy of each particular system is „*n joules*", we in fact mean that its energy is equivalent to its time $E = f$, as $E_A = joule = 1$. This is simple mathematics applied to the physical world.[10]

According to thermodynamics, thermal energy is transferred from one place to another by three processes: **conduction**, **convection,** and **radiation**. The first two terms describe the particular energy exchange between systems of matter; the third one describes the vertical energy exchange between matter and photon space-time. Radiation is assessed by two distinct laws - **Stefan-Boltzmann law** and **Wien's displacement law** (3.5). Conduction and convection are imprecise descriptive terms of anthropocentric origin. While conduction is reserved for heat transfer within a body without visible mass transport, convection circumscribes heat transfer by direct mass transport. The discrimination between the two terms is arbitrary and highly subjective. In fact, both terms are synonyms for the horizontal energy exchange between systems of matter.

Conduction and convection are described by a number of quantities that are similar to those of electromagnetism. The rate of change in temperature along the distance of an object is called the **temperature gradient** $\Delta T/\Delta x = f$ /[1*d-space*]. This quantity is of the same character as density (47) or pressure (68). It is a quotient of the two constituents of the thermal system, space and time (PCA). The quotient of thermal energy (heat) ΔQ and conventional time Δt is called **thermal current** $I = \Delta Q/\Delta t$. This quantity is the product of a vicious circle that is typical for all physical definitions. Its definition is: „If ΔQ is the amount of thermal energy conducted through the section (of an object) in some time Δt, the rate of conduction of thermal energy $\Delta Q/\Delta t$ is called the **thermal gradient** *I*. Experimentally, it is found that the thermal current is proportional to the temperature gradient and to the **cross-sectional area** ***A***."[11]:

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[10] The same method is applied to obtain different units of money and to establish the exchange rate of national currencies.

[11] PA Tipler, p. 525.

$$I = \frac{\Delta Q}{\Delta t} = kA\frac{\Delta T}{\Delta x} = \mathrm{SP(A)}[2d - space]f = E_A \qquad (76)$$

The hidden method of this circular definition is geometry. It involves the classical paradigm of considering space-time statically as structural complexity $E = K_s = \mathrm{SP(A)}[2d\text{-}space]$ when $f = \mathrm{SP(A)} = 1$, which is then described as a cross-sectional „area in motion". What one measures in reality is, however, not the thermal energy ΔQ, but its rate of conduction through the cross-section A of the conducting material in the time Δt: $I = \mathrm{A}/\Delta t = \mathrm{SP(A)}[2d\text{-}space]\, f$, where SP(A) stands for Δ.

The definition of thermal current is identical to the definition of **electric current** I, as the name and symbol suggests. Like the thermal energy ΔQ, electric charge is also expressed as area $Q = area = K_s = \mathrm{SP(A)}[2d\text{-}space]$ (see 4.2). Therefore, it is no coincidence that physicists have resorted to the same symbol for thermal energy and charge - "Q". The same holds true for the **thermal resistance** $R = \Delta x/kA$, which is equivalent to the **electric resistance** R.

The first law of thermodynamics is a statement of the conservation of energy. Its principal flaw is to project this property of the primary term to its U-subset „heat" or „thermal energy". The whole is defined through the part. This creates a paradox with respect to the second law. The first law says: „The net heat added to a system equals the change in the internal energy of the system plus the work done by the system."[12] As already pointed out, by „internal energy" one means the average kinetic energy of the mol-level $\Delta U = K_{av}$ (73a). The work is expressed by the law of Gay-Lussac (70):

$$Q = \Delta U + W = K_{av} + dW = 3/2nRT + PdV = E_A f \qquad (77)$$

Depending on the geometric method of measurement, one acquires different values for the numerical quotient of Boltzmann's law for the internal energy of gases ($U = 5/2nRT$) and solids ($U = 3nRT$). The first result is obtained from the so-called **equipartition theorem** of gases, while the second result is known as **Dulong-Petit law**. According to the latter law, the **molar heat capacity** $C_m = Mc$ of most metals is approximately $C = 3R = 24.9$ J/mol × K. We shall use this result to prove that the ther-

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[12] PA Tipler, p. 537.

modynamic level is an open level that participates in an incessant energy exchange with the levels of particles. In this way we shall confirm the new interpretation of the kinetic theory of gases (3.3).

Thermodynamics gives no explanation as to why the internal energy of material systems should be set equivalent to the kinetic energy of the thermodynamic level, which is just one of the infinite levels of matter, while at the same time the much greater energy of the levels of particles is completely neglected. This flaw stems from the deterministic approach in physics. However, as all levels of space-time are U-subsets, the thermodynamic level contains the underlying levels of the particles as an element. The reason is that this level exchanges energy with the particle levels and its space-time can change relatively from one object to another. Depending on the amount of energy exchanged, the overall effect that can be observed is either **expansion** or **contraction** of space as assessed by the change of volume in thermal systems. These changes in space are assessed by the temperature, which is a particular quantity of time for this level. Expansion and contraction are thus macroscopic events, which are measured in thermodynamics, and can be transformed into work by **heat-engines**.

Thermal expansion or contraction of material systems always involves the vertical energy exchange with the photon level, as it is a U-subset of space-time. We have postulated that energy exchange is vertical and horizontal at once. Therefore, there is no difference between the transport of heat and the propagation of gravitation - both levels of space-time are involved in the vertical energy exchange between matter and photon space-time and obey the Law. Space-time is a unity.

This will be proven for metals. According to Dulong-Petit law, the **molar heat capacity** C_m of most metals is almost constant at high temperatures:

$$C_m = 3R = 3k_bN_A = Mc \tag{78}$$

We shall now prove that the **specific heat** $c = C/m = f$ of each metal is a function of the energy exchange between the particle levels and the photon level. For this purpose, we depart from equation (46b), which is an application of UE for the mol-level and substitute Avogadro's number with the following formula as obtained from (78): $N_A = Mc/3k_b$:

$$M = m_p(n_{pr} f_{c,pr} + n_n f_{c,n} + n_e f_{c,e}) \frac{Mc}{3k_b} \tag{79}$$

This equation considers all elementary particles in the atom, such as electrons, protons, and neutrons; *n* gives the number of particles in the atom. We can eliminate the molar mass *M* and solve the equation for the **specific heat**:

$$c = \frac{3k_b}{m_p(n_{pr} f_{c,pr} + n_n f_{c,n} + n_e f_{c,e})} = \frac{E_{A,thermo}}{E_{A,particles}} = \mathrm{SP(A)} = K_{1,2} \tag{79a}$$

Equation (79a) is the Law as an RT applied to the vertical energy exchange between the microscopic thermodynamic level with the **molecular action potential** $E_{A,thermo} = (3)k_b$ and the kinetic energy of K_{av}, and the levels of the particles with the **aggregated action potential**: $E_{A,particles} = m_p n_{particle} f_c = m_p f = K_s f = \mathrm{SP(A)}[2d\text{-}space] f$. The outstanding result of this new application of the Law is that the specific heat of each material system is a function of the mass (energy relationship) of the basic photon m_p. This proves that the magnitude of the thermal energy depends on the vertical energy exchange between matter and photons (see Stankov's law in 3.7).

3.5 LAWS OF RADIATION (ND)

Heat is transferred by conduction, convection, and radiation. The first two processes describe the horizontal exchange of heat between material systems, while **radiation** is a synonym for the vertical energy exchange between matter and photon level. Thermodynamics has elaborated two distinct laws of radiation - **Stefan-Boltzmann law** and **Wien's displacement law.** We shall show that these laws are equivalent derivations within mathematical formalism and are thus concrete applications of the Law. We begin with **Stefan-Boltzmann law**. It says that the rate at which an object radiates thermal energy is proportional to the area of the object and to the fourth power of its absolute temperature:

$$P = e\sigma A T^4 = E \tag{80},$$

where P is the **power of radiation**, A is area, e is **emissivity** of the object, and σ is a universal constant, called **Stefan's constant**. Stefan-Boltzmann law is a solution of UE for the quantity power (14). The emissivity e is a numerical relationship that varies from 0 to 1 = SP(A). This law is often presented as an input-output law: $P = e\sigma A(T^4 - T_0^4)$, where T_0 is the temperature of the surroundings. This expression acknowledges the fact that radiation is a vertical energy exchange between matter and photon level that occurs in both directions. It also gives rise to the idea of an **ideal blackbody** that absorbs all the radiation incident upon it. The theoretical emissivity of this closed system of abstraction should be $e = 1$, which is an iteration of the certain event. An ideal blackbody is an intuitive perception of the closed character of space-time that is projected onto a material system (U-subset). According to PCA, the idea of a blackbody is a prerequisite for the definition of the laws of radiation, which are particular applications of UE for the vertical energy exchange between matter and photon space-time.

Stefan-Boltzmann law illustrates the degree of mathematical freedom that allows us to express the Law by different formulae. This law of radiation is of the same origin as Boltzmann's law of kinetic energy - for each system of radiation with a constant space-time, that is, $e\sigma A = cons.$, the energy of radiation depends only on the temperature $P \approx T^4$. The same holds in Boltzmann's law $K_{av} \approx T$. The fourth power of T is without relevance - according to the new axiomatics, space-time or its constituents can be expressed n-dimensionally or at the n-power without affecting the validity of the primary axiom (PLE). We shall confirm this axiomatic conclusion by explaining the ontology of Stefan-Boltzmann law from our mathematical consciousness. This law assesses the power of the emitted photons. In this case, „power" is an abstract meta-level of the photon energy E_p, which is expressed as a function of time $f = 1/t$: $P = E_p f$. For didactic purposes, we shall present the different time quantities nominalistically with f, although they may have a different magnitude. The actual energy of photons is given by Planck's equation $E_p = hf$. We write for their power $P = hf^2$. The basic photon can be expressed as follows: $h = m_p c^2 = m_p \lambda_A{}^2 f^2 = \text{SP(A)}[2d\text{-}space]f^2$. When we set the basic photon from the above formula in Stefan-Boltzmann law, we obtain the exact dimensionality of the parameters used in this law:

$$P = e\sigma AT^4 = m_p\lambda_A{}^2 f^4 = \mathrm{SP(A)}[2d\text{-}space]f^4 = K_s f^4,$$

$$\text{where } T = f \tag{80a}$$

From this equation, one can easily obtain the dimensionality of the three parameters of Stefan-Boltzmann law: e = SP(A), σ = SP(A) and $A = [2d\text{-}space]$. The term $K_s = e\sigma A$ = SP(A)[2*d*-*space*] gives the constant space-time of the system of radiation as an area. These quantities belong to the emitting system of matter, but they can also be derived from the structural complexity of the basic photon $K_s = m_p\lambda A^2$ when UE is applied. We leave this exercise to the reader.

We obtain the same result when we depart from **Wien's displacement law**. This law determines the **wavelength** of the emitted photons at which the maximum power is observed:

$$\lambda_{max} = \frac{B}{T}, \text{hence } B = \lambda_{\max} T = [1d - space]\, f =$$

$$= [1d - space - time] = \mathsf{v} \tag{81}$$

We gather from equation (81) that **Wien's constant of proportionality *B*** is one-dimensional space-time of matter, that is, velocity. At present, this law is very poorly understood. Especially the importance of the constant B has been overlooked. We shall correct this mistake. When we set $\lambda_{\max} = B/T$ from Wien's displacement law in the formula of the speed of light $c = \lambda f$, and present it as an RT, we can show that B is a velocity:

$$\frac{c}{f} = \frac{B}{T} = \frac{[1d - space - time]}{f} = [1d - space] = \lambda_{max} \tag{81a}$$

The **constant** B is one-dimensional space-time of a **novel material level** of thermodynamics that has evaded the attention of physicists. As a U-subset of matter, this level contains the thermodynamic, kinetic level of the molecules as an element. This level determines the space-time of the emitted photons, that is, their wavelength (space) and frequency (time) with respect to temperature, which is a quantity of material time. When we solve equation (81a) for the frequency of the emit-

ted photons at which the maximum power is observed, we obtain a **new constant** of fundamental importance in cosmology:

$$f_{max} = (c/B)T = K_{CBR}T = \mathrm{SP(A)}T = 1.0345 \times 10^{11} \times T \qquad (82)$$

The new constant of proportionality $K_{CBR} = c/B$ is an absolute constant, as both c and B are one-dimensional space-time (velocities). We call it the **constant of cosmic background radiation, CBR,** and use the symbol $\boldsymbol{K_{CBR}}$. Although we call K_{CBR} a constant of the cosmic background radiation, it holds in any kind of radiation. We have chosen this particular name because K_{CBR} helps us to refute the „big bang“ hypothesis and the standard model of cosmology postulating the expansion of the universe (see section 7.). Based on this constant, we can interpret Stefan-Boltzmann law in terms of knowledge. When we solve equation (82) for the temperature $T = f_{max}/K_{CBR}$ and substitute this quantity in Stefan-Boltzmann law, we obtain the power of the emitted photons as a function of their frequency:

$$P = \frac{e\sigma A}{K_{CBR}^{\ 4}} f^{\,4}{}_{max} \qquad (83)$$

This is already known from Planck's equation $E = hf$. From the two laws of radiation, the novel **Stankov's law** of photon thermodynamics is derived in 3.7. As with all previous laws, it is an application of the Law. We shall use this law to refute the wrong idea of „growing entropy“, as postulated in the second law of thermodynamics.

3.6 ENTROPY AND THE SECOND LAW OF THERMODYNAMICS (ND)

The **second law of thermodynamics**, also called the „**law of entropy“**, is a consequence of the first law - or more accurately, it is a consequence of the flaws committed by the formulation of the first law. The definition of conservation of energy departs from heat and involves the anthropocentric term „work“ (77). This highly subjective definition of the first law has inevitably produced a collection of ideas that have obscured thermodynamics. The anthropocentric idea of “work“ is intrinsically linked to the

notion of the „**availability of energy**“, which is basic to the second law:

> “...The first law does not tell the whole story. Energy is always conserved, but some forms of energy are more useful than others. The possibility or impossibility of putting energy to use is the subject of the second law of thermodynamics.“[13]

This quotation should be sufficient to reject the second law and discredit physics as an objective science that is independent of human prejudices, as physicists would like to see it. The idea of the „usefulness“ of energy may play a role in production (as mechanical work), but never in theoretical science. The human experience is that it is easy to convert mechanical work or the internal energy of a system (K_{av}) completely into heat with no other changes, but it is impossible to remove heat or internal energy from a system and convert it completely into mechanical work with no other changes. The reason for this is that energy exchange at the thermodynamic level is open and involves all levels of space-time. In the first place, it is a vertical energy exchange between matter and photon level as demonstrated by the two laws of radiation. Only when this process is regarded unilaterally from the point of view of matter does it give the impression of being „irreversible“. This is the subjective view of conventional thermodynamics:

> „There is thus a lack of symmetry in the roles played by heat and work that is not evident from the first law. This lack of symmetry is related to the fact that some processes are irreversible... This experimental fact is one statement of the second law of thermodynamics.“[14]

Motion with **kinetic friction** is an example of this irreversibility of heat exchange. If there were no friction, we might be able to develop a perpetuum mobile (=space-time). The story is old and, as with most familiar issues, it has been profoundly misapprehended. The preoccupation of physics with heat has one simple reason: most of the power engines used at present are heat engines based on the **combustion** of gas, coal, and fuel, that is, the bulk of the energy that is available to us today is ob-

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[13] PA Tipler, p. 563.
[14] PA Tipler, p. 563.

tained from the burning of organic matter, which is a product of **photosynthesis**. Both terms, combustion and photosynthesis, describe the energy exchange between matter and photon level that takes place in both directions. Photon energy is the primary source of building organic matter, such as plants. Thus, photosynthesis stands for the energy conversion from photon space-time to organic space-time. Plants are the origin of gas, coal, and fuel. In particular, they have enriched the atmosphere with oxygen through photosynthesis and have thus created favourable conditions for the development of animals and human beings with consciousness, but also for the combustion of organic fuels by man.

When thermal energy is used by humans, most of the heat is **radiated** as photons (Stefan-Boltzmann law, Wien's displacement law), and only a small portion of it is transformed into work. The portion of thermal energy that is converted into photon energy is defined as **lost work** W_{lost}. Exactly this irreversibility of available energy from the human point of view is the topic of the second law. It begins with the elucidation of the **efficiency** of thermal energy with respect to work:

$$\in = \frac{W}{Q_h} = \frac{Q_{hot} - Q_{cold}}{Q_h} = \frac{dQ}{Q_h} = \frac{dE_{thermal}}{E_{available}} = \mathrm{SP(A)} \qquad (84),$$

where dQ is called the **heat reservoir**. The **efficiency** $\in$ is a coefficient of the horizontal heat exchange between the systems of matter. As space-time exchange always involves a horizontal and a vertical exchange, this coefficient is, in fact, a function of the energy exchange between matter and photon space-time. As we are still not in a position to use the energy of photon space-time for mechanical work in heat engines, the portion of thermal energy that is transferred from matter to photon level by radiation is virtually lost for practical purposes. If we assume that there is no vertical energy exchange between matter and photon space-time by radiation, we get for the efficiency $\in = 1$ (closed system). This is, however, impossible. This experimental result is known as the **Kelvin-Planck** or **heat engine statement of the second law of thermodynamics**: „It is impossible for a heat engine working in a cycle to produce no other effect than that of extracting heat from a reservoir and performing an equivalent amount of work."[15]

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[15] PA Tipler, p. 567.

There are many variations of this statement that obscure thermodynamics. A very popular definition is the „**refrigerator" statement** of the second law of thermodynamics: „It is impossible for a refrigerator working in a cycle to produce no other effect than the transfer of heat from a cold to a hot object."[16] The reader may figure out how many statements of the second law are possible when one considers all the different heat engines which we use in daily life. This example underlines our initial conclusion that the second law of entropy is a **subjective** interpretation of the first law of the conservation of energy with respect to work.

The logical consequence of this subjective view in thermodynamics is the formulation of the **Carnot theorem:** „no engine working between two given heat reservoirs can be more efficient than a *reversible* engine working between those reservoirs."[17] From the Carnot theorem, the **Carnot engine** has been developed - unfortunately, not in the real world, but in the imagination of physicists. The concept of the Carnot engine is another version of a closed system as an intuitive notion of the closed character of space-time. The primary axiom is vested in all physical concepts.

While the ideal Carnot engine is not in a position to produce energy, it has generated a collection of concepts of an abstract mathematical character. In the Carnot engine, one distinguishes between an **isothermal** process ($T = f = cons.$), which leads to expansion or compression of the space-time of material systems when pressure decreases or increases, and an **adiabatic** process ($P \cong E = cons.$), which also causes an expansion or compression when the temperature changes. The isothermal and adiabatic expansion or compression are ideal states of the thermal system that intuitively reflect the reciprocity of space and time, respectively, of space and energy for the level of matter. These states are introduced for didactic purposes and have the same explanatory function as the kinetic and potential energy in classical mechanics. They allow an assessment of space-time in a dualistic, that is, dynamic and static way. In reality, energy exchange is an interrelated motion - any thermal energy exchange leads to simultaneous changes in both temperature (time) and pressure (energy), and subsequently in space (volume). Space-time is the only real thing, while all quantities are abstract U-subsets of the primary term. For this reason we can only consider these quantities as abstract entities in the mind and modulate them for didactic purposes (degree of

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[16] PA Tipler, p. 568.
[17] PA Tipler, p. 569.

mathematical freedom). This is the actual meaning of the Carnot theorem, of which the Carnot engine is a virtual realisation.

The Carnot engine is used to determine the optimal efficiency of a heat engine with respect to work. In this calculation, the energy exchanged with the photon level is totally neglected - it is regarded as „irreversible“ and „completely lost“. When the actual efficiency of an existing heat engine is compared to the theoretical efficiency of the ideal Carnot engine, the relative efficiency of the heat engine is determined. This is called the **second law of efficiency** $\in_{SL} = \in / \in_{C} = SP(A)$.

The **law of entropy** (second law of thermodynamics) is the generalized form of this human experience with respect to heat: „All irreversible processes have one thing in common - the system plus its surroundings moves towards a **less ordered** state.“[18] The immediate question that this statement should evoke is: „What is the meaning of the term „surroundings“? The answer of thermodynamics to this question is turned upside down: „By „universe“, we mean the system plus its surroundings.“[19] When we translate this statement into logical terms:

$$system + surroundings = universe = thermal\ energy + energy =$$

$$= space\text{-}time = mathematical\ symbols$$

we obtain the primary axiom of our axiomatics according to PLE. Unfortunately, thermodynamics has failed to define the primary term. This omission has given rise to the second law. It is said to be a law of entropy. But what is entropy? We read in the literature that „there is a thermodynamic function, called **entropy *S*,** that is a measure of the „disorder“ of a system.“[20] Evidently, entropy is a synonym for disorder. „But what is disorder?“, should be our next question. Here we read:

“Like the pressure *P*, volume *V*, temperature *T*, and thermal energy *U*, entropy is a function of the state of a system. As with internal energy, it is the **change** in entropy that is important. The change in entropy ΔS of a system when it goes from one state to another is defined as

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[18] PA Tipler, p. 577.
[19] PA Tipler, p. 579.
[20] PA Tipler, p. 577.

$$\Delta S = \int \frac{dQ_{rev}}{T} = \mathrm{SP(A)}[2d - space]f = E_A \qquad (85),$$

where dQ_{rev} ($\mathrm{d}Q_{rev} = E = \mathrm{SP(A)}[2d\text{-}space] = K_s$, when $f = 1$; see thermic current (76)) is the heat that must be added to the system in a reversible process to bring it from its initial state to its final state."[21]

From this definition, it is cogent that the novel term „entropy" departs from „disorder" and ends up with the primary term: entropy is defined as the „change in energy" per time with respect to the U-subset „heat" $dQ_{rev} = \Delta ST = E_A f = E$. The universal event of energy exchange is the action potential. Thus:

> The **„change in entropy"** is an **action potential** of the **thermodynamic level**: $\Delta S = E_A$.

This is an axiomatic conclusion from the above definition that will be substantiated by the various mathematical expressions of the law of entropy. All of them depart from the first law of thermodynamics as presented in equation (77) and are thus mathematical iterations of the Law. We shall skip their method of derivation, which is mathematics (geometry, algebra, and theory of probabilities), and shall only write the final results:

$$\Delta S = C_p \ln \frac{T_2}{T_1}(1) = nR \ln \frac{V_2}{V_1}(2) = nN_A k_b \ln \mathrm{SP(A)} \qquad (86)$$

Equation (86) is Boltzmann's law for the mol-level (73a). It is obtained by setting the entropy equivalent to the change of heat in equation (85): if $T = f = cons. = 1$ (isotherm = certain event), then $\Delta S = dQ_{rev} = K_{av}$. We conclude again:

> The **entropy** is a quantity that assesses energy exchange at the thermodynamic level**.**

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[21] PA Tipler, p. 577.

Equation (86) also confirms that the temperature $T_2 / T_1 = V_2 / V_1$ is a relationship of [3*d-space*]: when $T_1 = 1 =$ *certain event* or 1 *unit*, then $T_2 = \mathrm{d}V_2$ (thermometer). Equation (1) in (86) is obtained for adiabatic conditions within mathematics: C_p is the heat capacity when $P \approx E = cons.$ Equation (2) is obtained for an isothermal process ($E \approx T = f = cons.$). Both states are abstractions - they illustrate that we can only measure time (T) and space (V) in a separate way. However, space-time is a unity.

As we see, the mathematical presentations of the second law of entropy are adequate applications of UE - they are iterations of Boltzmann's law and the first law of thermodynamics within mathematical formalism. They depart from the assumption that Q is reversible Q_{rev}. In fact, it is not. This has triggered a collection of non-mathematical interpretations of the second law that have led to a fundamental paradox in thermodynamics. We call it the „**antinomy**" between the first and second law of thermodynamics. All paradoxes and antinomies in physics and science are introduced by inconsistent and illogical interpretations of correct mathematical results in non-mathematical terms. This systemic failure of science could be eliminated for the first time by the discovery of the Universal Law and the development of the new axiomatics of science based on a single term. In order to underline this critical analysis, we shall present some typical interpretations of the second law that „ghostbuster" in the literature and embody the antinomy of the first and second law of thermodynamics:

> „In a **reversible** process, the entropy change of the universe is zero ($\Delta S = 0$). By „universe" we mean the system plus its surroundings (see above)."[22]

> „In an **irreversible** process, the entropy of the universe **increases**. For any process, the entropy of the universe never decreases. In an irreversible process, energy equal to the entropy change of the universe times the temperature of the coldest available reservoir becomes unavailable for doing work $W_{lost} = \Delta ST = K_{av}$ (85)"[23].

We summarize the two major statements of thermodynamics that lead to a logical antinomy:

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[22] PA Tipler, p. 579.
[23] PA Tipler, p. 579-580.

1. $S = E = cons.$, or $\Delta S = \Delta E = 0$.	This is the first law of conservation of energy as iterated by the second law for **reversible** processes.
2. $\Delta S = \Delta E \geq 1$, or $S = E$ grows.	This is the the second law of entropy for **irreversible** processes. It is equivalent to the idea of an expanding universe.

From this presentation, it is cogent that the antinomy between the first and the second law stems from the inability of physics to define the primary term, although the definition of „world entropy“ is a hidden definition of space-time. None of the non-mathematical definitions of thermodynamics can explain entropy without introducing the primary term, for instance, as „surroundings“ or „universe“. This antinomy is eliminated by the primary axiom of the new axiomatics: universe = energy = = space-time = constant. The constancy of space-time is manifested by the parts, such as heat. The quantity „entropy“ is defined within mathematics as the action potential of the thermodynamic level that should be constant - hence its equivalence to Boltzmann's constant k_b. This fact becomes evident when we look at the **probabilistic** presentation of entropy, which departs from Boltzmann's law ((85) & (86)):

$$\Delta S = R/N_A ln\ p = k_b ln\ p = k_b 3T/2 = k_b \mathrm{SP(A)} = E_A\, f \qquad (87),$$

where $p = \mathrm{SP(A)}$. This is the microscopic expression of Boltzmann's law. When we set $\mathrm{SP(A)} = ln\ p = 1$, we obtain for the entropy:

$$\Delta S = k_b = E_{A(micro)} \qquad (87a)$$

> **Entropy** is the **molecular action potential** of the **thermodynamic level** as defined by the theory of probabilities (method of definition = method of measurement).

This insight effects another great simplification in our outlook of nature. It can be illustrated by means of the not-so-famous **third law of thermodynamics,** known as **Nernst's theorem of heat**. We shall use Planck's

interpretation of this law. It says: “at the absolute zero point (kelvin), the entropy of completely ordered crystals is zero. If the entropy of any element is set zero at this state, then the entropy of any compound of elements will have a positive entropy.“ Recall that the absolute zero point of the Kelvin scale is obtained when the straight line in the plot of pressure versus temperature is extrapolated to zero pressure. Therefore, the method of definition of the absolute zero point is mathematics. The extrapolation to zero pressure departs from the notion of homogeneous space-time, by attributing the number „0“ to a hypothetical state of matter that can never be obtained in reality. The idea of homogeneous space-time is thus the ontological background of zero.

The key message of the third law is that we can arbitrarily ascribe the number „zero“ to any of the quantities of the thermodynamic level, for instance to $T = 0$ and $P = 0$. This would mean that we practically eliminate the space-time of the thermodynamic level $E = K_{av} = 0$. At this ideal zero-state of the thermodynamic level there should be no thermal energy exchange with the photon level: if $K_{av} = 0$, then $k_b = \Delta S = entropy = 0$. Only under this abstract condition do we have a reversible thermodynamic process. However, this process has nothing to do with real space-time - it is a product of the degree of freedom of our mathematical consciousness. For this reason, the third law acknowledges willy-nilly that any real material system will have a thermodynamic level with an action potential (entropy) that is greater than zero. This artefact born in the realm of mathematics is defined in thermodynamics as „**growing entropy**“: $\Delta S = k_b \geq 0$.

The notion of „growing entropy“ is a **one-sided definition of the probability set**: it simply implies that all real events, being action potentials, have the theoretical probability that they will occur at some time - therefore, their time or space is always greater than zero. As soon as the event has occurred, we can compare it with itself and obtain the certain event SP(A) = 1. When we apply this procedure to the primary term, we can write: *entropy* = *space-time* = 1 = *constant* (PLE). Therein lies the entire humbug of „growing entropy“ - it is not a real physical phenomenon, but a symptom of the mental state of the physicist’s mind at the end of the Second Millennium.

3.7 STANKOV'S LAW OF PHOTON THERMODYNAMICS (ND)

The entropy ΔS is a synonym for the action potential of the microscopic thermodynamic level $\Delta S = k_b$, while $\Delta S = Nk_b$ is the action potential of the macroscopic level, where $N = nN_A$. The definition of this quantity is also the method of its measurement. The change of entropy is measured by the macroscopic change in the kinetic (internal) energy of the object dK_{av}:

$$\Delta K_{av} = \frac{3}{2} N k_b \frac{\Delta T}{dt} = \frac{3}{2} \Delta S f_T f_t = \Delta S \ ,$$

$$\text{when } f = 3/2 f_T f_t = \text{SP(A)} = 1 \qquad (88),$$

where $\Delta T = f_T$ and $\Delta t = 1/f_t$. Equation (88) summarizes the physical experience that when there is a temperature difference ΔT at the level of matter, we always observe a heat exchange, called thermal current $\Delta Q/\Delta t = \Delta K_{av}/\Delta t = I$ (76), which flows from the higher temperature to the lower temperature during the period Δt. The heat exchange is completed when the difference of the temperature is equalized $\Delta T = T_{max} - T_{mean}$. The time T of the thermodynamic level tends towards a mean constant value $T_{mean} = f_{thermo} = cons.$, because the space-time of this level is constant. When we observe this energy exchange only at the material level, we never come across a process where there is an energy exchange from a lower temperature to a higher temperature. This experience has led to the wrong idea of growing entropy in the universe. The origin of most wrong ideas in physics and in science lies in the human propensity to depart from a local experience and then generalize it. Whenever the epistemological arrow points from one part to other larger parts of the whole, the human mind is prone to arrive at wrong conclusions (vicious circle). Only when one departs from the whole is it possible to comprehend the parts, which contain the whole as an element. This is the basic principle of the new axiomatics.

The reduction of the temperature difference at the material level, which is conventionally interpreted as an increase of entropy, is, in fact, associated with an **equivalent reciprocal increase of the temperature difference at the photon level.** As this level has not been an

object of study in thermodynamics - it is considered a vacuum -, this aspect has been overlooked. The reciprocal behaviour of the temperature (time) at the material and photon levels is a consequence of the reciprocity of space and time. Entropy is a synonym of the action potential of the thermodynamic level $\Delta S = \Delta K_{av} = E_{A,thermo}$ (88). According to CAP, this action potential is completely transformed into the action potential of the photon level during the vertical energy exchange between these two levels $E_{A,thermo} = E_{A,photon}$. The two action potentials behave reciprocally: when $E_{A,thermo}$ disappears, as it is measured by ΔT at the level of matter, an equivalent $E_{A,photon}$ is simultaneously created at the photon level with the time ΔT. Within mathematics, we have the degree of freedom to describe each action potential as an *LRC* and vice versa: $E_A = LRC \approx \Delta T = f$, that is, when $LRC_{thermo,matter} \approx \Delta T = f \rightarrow 0$, then $LRC_{thermo,photon} \approx \Delta T = f \rightarrow max$, or:

$$LRC_{thermo,\ matter} = -\ LRC_{thermo,\ photon} \qquad (89),$$

respectively,

$$\frac{\left|LRC_{thermo,matter}\right|}{\left|LRC_{thermo,photon}\right|} = 1 = constant \qquad (89a)$$

The above equations express the reciprocal behaviour of the *LRCs* of contiguous levels. Both equations are equivalent mathematical presentations of the constant character of space-time (primary axiom) and the reciprocity of space and time. In (89) this leads to the introduction of the continuum of negative numbers as a mirror image of the continuum of real positive numbers. In (89a) we apply PCA to build a ratio of the parts (thermodynamic and matter level). According to AR, we can consider the thermodynamic level of the universe (space-time) E_{thermo} as a product of two entities, matter and photon space-time, that interact:

$$E_{thermo} = E_{thermo,matter} \times E_{thermo,photon} = 1,$$

or
$$E_{thermo,matter} = 1/E_{thermo,photon} \qquad (89b)$$

This is a third equivalent presentation of thermodynamic space-time within mathematics. The three equations, (89), (89a) and (89b), demonstrate the intrinsic propensity of mathematics to express the pri-

mary term in different ways. Space-time is the origin of all mathematical operations.

This theoretical elaboration holds in any subset of space-time. It will be supported by the derivation of a novel application of the Law for the **thermodynamic photon level**. For this purpose we take Planck's equation of photon energy $E_p = hf$, which is an application of UE for this level, and solve it for the frequency of the maximal radiation as assessed by Wien's displacement law $f_{max} = c/\lambda_{max} = (c/B)T = K_{CBR}T$ (82). This law of radiation describes the vertical energy exchange between matter and photon space-time (see 3.5):

$$E_p = h\, f_{max} = hc/\lambda_{max} = h(c/B)T = hK_{CBR}\, T = E_A\, f \tag{90}$$

Equation (90) expresses photon energy as a function of temperature. It is an application of UE for the **thermodynamic level** of photon space-time. The action potential of this level $E_{A,thermo} = hK_{CBR}$ is a **new natural constant** because it is a product of two other constants. We call it **Stankov's constant k_s:**

$$k_s = h(c/B) = hK_{CBR} = 6.85 \times 10^{-23} \tag{91}$$

When this constant is given in the SI system, it has the units [JK^{-1}]. In reality, it is a numerical relationship. We can now describe the energy of the thermodynamic level of photon space-time with the universal equation:

$$\boldsymbol{E_{p,thermo} = k_s T = E_A\, f} \tag{92}$$

This is called **Stankov's law of photon thermodynamics.** It says:

> When a thermal difference ΔT is abolished at the material level during a period of Δt, and no work is done, the change of the kinetic (internal) energy at the level of matter (88) is equivalent to the change at the thermodynamic level of photon space-time (axiom of CAP):

$$\Delta K_{av} = \Delta E_{p,\,thermo} = k_s \Delta T/\Delta t = k_s\, f_T f_t = k_s\, f \tag{92a}$$

In terms of knowledge, we can explain this vertical energy exchange as follows. When T is maximal at the level of matter, photons with a maximal energy are emitted $E_{p,max} \approx f_{Tmax} \approx T_{max}$ (90). When the maximal temperature reaches the temperature of equivalence T_{mean}, the energy of the emitted photons becomes minimal $E_{p,min} \approx f_{Tmin} \approx T_{mean}$. The maximal and minimal energy of the emitted photons build an **energy gradient** at the photon level $\Delta E_p = LRC_p \approx \Delta T_{max}$ during the period of Δt. This energy gradient can be regarded as a distinct system of photon space-time with the time $f = 1/\Delta t$. It belongs to a new level of space-time, called the „**thermodynamic level of photon space-time**". It goes without saying that this level is closely linked to the thermodynamic level of matter. In this way infinite levels of space-time can be defined. It is extremely important to keep in mind that such levels are U-subsets that contain themselves as an element and therefore can only be separated in the mind. This aspect of the primary term presents the greatest cognitive difficulties to the conventionally educated physicist.

The derivation of Stankov's law eliminates the fundamental paradox of science as embodied in Boltzmann's notion of growing entropy in inorganic matter (second law) versus the evolution of organic matter, as first put forward by Darwin, which is also viewed as a product of growing "**negentropy"** (Schrödinger[24]).

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[24] In his book „What is life?".

4. ELECTRICITY, MAGNETISM, AND ELECTROMAGNETISM

4.1 ETYMOLOGY OF CONCEPTS

The etymology of the concepts **electricity**, **magnetism,** and **electromagnetism** reveals that physics has developed an intuitively correct perception of space-time as an entity consisting of open U-subsets that can only be discriminated in the mind. All physical phenomena caused by the „motion of charges" are subsumed under the term „electricity". We shall prove that **charge** is a synonym for structural complexity K_s (4.2). This quantity is assessed as **area** by the conventional geometric method of definition and measurement of physical quantities: $Q = K_s$ = SP(A)[2*d-space*] = *area*. The paradigm „K_s in motion" is thus not only basic to most conventional laws (1.6), it also determines the etymology of „electricity".

In this context, the electric level is regarded as the **aggregated subset** of matter that includes the microscopic levels of particles (e.g. electrons, neutrons, protons, quarks, etc.) and the macroscopic levels of matter (e.g. electric motors and devices). It is a well known fact that all particles have a charge. We shall show that the basic photon also has a charge, that is, space. The voluntary decision to select the charge (area) of the electron as the **fundamental unit of charge** *e* is a pure convention of physics. This unit can be substituted by any other unit of area, e.g. 1 *meter*. The charge (area) of all other levels and systems of electricity are conventionally expressed as the product of *e* by applying UE to this quantity (principle of similarity): $Q = ef$, where f = the continuum of integers. This preference for the integers over the other numbers of the continuum goes back to *Millikan's oil-drop experiment*, with which the area of the electron was first measured[25].

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[25] A detailed description of this experiment is given, for instance, in M. Carplus & R.N. Porter, Atom and molecules, W.A. Benjamin, 1970, p.14-17. The method of measurement of electric charge in this experiment is geometry, so that the definition of *e* is K_s = *area*.

The experience with electromagnetic forces has confirmed that, like gravitational forces, they interact **at a distance**. The assessment of such interactions must inevitably consider the vertical energy exchange between matter and photon space-time. Just as Newton's law of gravity appears to be a hidden definition of the vertical energy exchange between the gravitational level of matter and the photon level (1.7), so do Coulomb's law and all other derivations of the Law at the electric level: they introduce the space-time of the photon level as a reference system, with which the electric interactions between the material systems of the electric level are compared according to PCA. This will become evident when we discuss the background of the two basic constants of electricity, the permeability and permettivity of free space (4.3).

While the static view of electricity prevailed at the beginning of this discipline - hence the term „**electrostatics**" - this view has become more and more dynamic in the second half of the nineteenth century, and has led to the development of **electrodynamics**. Finally, the concept of **electromagnetism** has been introduced in physics. This etymological fact embodies the insight that space-time is an entity of open U-subsets. The static view of physics has produced two distinct laws of electricity, **Coulomb's law** of **static charges** and **Gauss's law** of the **electric flux**. Both are based on the concept of **electric fields**, just as Newton's law of gravity is based on the idea of gravitational fields. „Field" is a circumlocution of photon space-time when this level is epistemologically regarded as vacuum. This quantity is a consequence of the idea of void space.

The concept of the field as an „action at a distance" is a systemic flaw. This static view allows the abstract definition of the **magnetic field** as an entity which is distinct from the electric field. The magnetic field is basic to the definition of several laws of magnetism, such as **Biot-Savart law**, **Ampère's law**, and **Gauss's law of magnetism.** The impossibility of discriminating between the two phenomena, electricity and magnetism, first becomes evident in **Faraday's law**, which departs from the magnetic field and ends up with the electric field (**Stoke's integral theorem of Ampère's law**). These laws are mathematical iterations of the Law. They document the gradual evolution of the physical outlook from the static towards a more dynamic point of view, as finally expressed by Maxwell. His achievement was the integration of all partial laws of electricity and magnetism into his famous **four equations of electromagnetism** by introducing the concept of the **displa-**

cement current. We shall show that this quantity is a synonym for the **universal action potential of electromagnetism**. Maxwell's partial unification of physics in the field of electromagnetism can be regarded as the main precursor of our universal axiomatics of physics and mathematics based on a single term. For this reason, we often speak of **Maxwell's electromagnetism,** just as we speak of **Newtonian mechanics**.

Before we proceed with our discussion of electromagnetism, we should stress a simple fact: all the energy interactions which we encounter in daily life are of gravitational and electromagnetic origin. Especially the electromagnetic interactions are responsible for the shape and forms of material objects, beginning with the shape of mountains that will be normally flattened by gravitation and ending up with the crystal structure of substances. Nuclear and weak forces as defined in the standard model are of purely theoretical character - they are abstract U-subsets of space-time.

4.2 BASIC QUANTITIES AND UNITS OF ELECTRICITY (ND)

The units of the SI system can be reduced to seven (actually six) fundamental units and their corresponding quantities (dimensions). We have proved that space-time has only **two** dimensions - the two constituents, **space** and **time**, which are dialectically linked and behave reciprocally. All quantities can be derived from these two dimensions (Table 2). We have already shown that the three fundamental dimensions and their units - mass in *kg* (1.8 & 1.9), temperature in *grad* kelvin (3.1), and amount of substance in *mole*/*mol* (1.9) - are derived from space and time, or space-time. We shall now prove that the remaining two quantities and their SI units - **charge *Q*** with the SI unit „**coulomb**" (**C**) and **current *I*** with the SI unit „**ampere**" - can also be derived from the primary term. As the two quantities are defined in a circular manner, they can be regarded as one fundamental quantity and unit:

> (1) „The SI unit of charge is the coulomb, which is defined in terms of the unit of electric current, the **ampere** (The ampere is defined in terms of a magnetic-force measurement...). The **coulomb** (C) is the amount of charge flowing through a **cross-sec-**

> **tional area** (*A*) of a wire in one second when the current in the wire is one **ampere**."[26]

> (2) „If ΔQ is the charge that flows through the **cross-sectional area** A in time Δt, the current is $I = \Delta Q/\Delta t$. The SI unit of current is the **ampere** (A): 1A = 1C/s."[27]

As we see, this tautological definition of charge and current is based on the geometric method of measurement of their units. Actually, it is based on the definition and measurement of the (electro)magnetic force. The latter is a quantity assessing the space-time of the **electromagnetic level** $E_{em} = F_{em}$ = SP(A)[1*d-space-time*] *f*, when s = SP(A) = 1 This force is also called **electromotive force** (**emf**).

The above definition implements mathematics inconsistently and introduces a systemic flaw in electricity that extends throughout the whole edifice of physics. This has not been realized so far. When the non-mathematical definition of the electric current (2) is presented in mathematical symbols in physics, the quantity „cross-sectional area *A*" is **omitted** without any reason: $I = \Delta Q/\Delta t$. This omisson in the mathematical presentation of the current is a fundamental formalistic mistake with grievous cognitive consequences for this discipline. This becomes evident when we express the present formula of the current in non-mathematical terms: electric current I is the charge ΔQ that flows during the time Δt, or alternatively: "current is charge per time". This definition is meaningless, as „physics does not know what charge is"[28].

In reality, the current is measured in relation to the *cross-sectional area* A = [2*d-space*] of the conductor (PCA). When mathematical formalism is applied to physics in a consistent way, the correct presentation of the above definition of the **electric current** and its unit **ampere** should include the cross-sectional area, as this quantity is explicitly introduced as a reference system:

$$I = \frac{\Delta Q}{A\Delta t} = 1\text{ampere} = \frac{1C}{1\text{m}^2\Delta t} \tag{93}$$

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[26] PA Tipler, p. 600.
[27] PA Tipler, p. 717.
[28] PA Tipler, German ed., p. 618.

When we set the time $f = 1/\Delta t = \mathrm{SP(A)} = 1$, we obtain for the current unit 1 *ampere* = 1 *coulomb*/1 m^2. In order to understand equation (93), we must know what the unit 1 *ampere* really means. As with all physical definitions, the definition of this unit is at the same time the method of definition and measurement of the quantity **electric current**:

> „If two very long parallel wires one meter apart carry equal currents, the current in each is defined to be one ampere when the force per unit length on each wire is 2×10^{-7} N/m."

This definition is an application of AR for two arbitrarily selected, equal electric systems that interact with each other. This interaction takes place at a distance of $R = 1$ *m* and is mediated through the vertical energy exchange between these material systems and photon space-time. The actual interaction is between the magnetic fields, which are built around the two equal electric segments $I_1\Delta l_1 = I_2\Delta l_2$, where $\Delta l_1 = \Delta l_2 = \Delta l = 1$ *m* and $I_1 = I_2 = 1$ *ampere*. It results in a new system of space-time that is measured by the motion of the two electric systems. When the currents flow in the same direction, the wires are attracted; when the currents are antiparallel, the wires are repelled. This motion, which is a manifestation of the space-time of the resultant system, is assessed as an **electromotive force (emf)**:

$$F = \frac{\Delta l}{R}\times\frac{\mu_0}{2\pi}\times I_1 I_2 = \frac{\mu_0}{2\pi} = 2\times10^{-7}\left[\mathrm{Nm^{-1}}\right] \qquad (94),$$

where $\Delta l/R = 1$ m/1 m = SP(A) = 1 and $I_1 = I_2 = 1$ *ampere* $= I_1 \times I_2 =$ $= \mathrm{SP(A)} = 1$. The definition of the ampere resorts to the number „1" as the universal symbol for presenting physical quantities. In reality, this is a hidden definition of the basic constant of electricity, the **permeability of free space** μ_0 (4.3), which is a quantity of photon space-time:

$$\mu_0 = 2\pi F = 4\pi10^{-7}\ [\mathrm{NA^{-2}}] \qquad (94a)$$

The measurement of the force that is acting on the two segments is, in fact, a measurement of the space-time of the system resulting from this interaction: $E = Fs = F$, when $s = 1$ m = SP(A) = 1. According to AR, its energy is a product of the interaction of the two currents $E = I_1 I_2$.

Departing from PCA, we can assign this energy the primary number „1“, e.g. as 1 *joule* with respect to the SI system:

$$E = I_1 I_2 = 1 = 1 \; joule$$

We have deduced this equation axiomatically from our mathematical consciousness. As any experiment is a tautology of the Law, the method of measurement of the current unit, ampere, should confirm the above equation. Indeed, when we solve equation (94) for the energy:

$$E = I_1 I_2 = \frac{2\pi F}{\mu_0} = \frac{2\pi 2\times 10^{-7}}{4\pi\times 10^{-7}} =$$

$$= \mathrm{SP(A)}\left[1d - space - time\right] f\left[1d - space\right] = 1\mathrm{joule} \qquad (94b),$$

we obtain the same result. In the light of the new axiomatics, the actual definition of the current unit **1 ampere** should be as follows:

> When the exchanged energy between two equal, arbitrarily defined electric currents (segments) placed at a distance of 1 m is 1 *joule* per *second* (introduction of the SI system), the space-time of each electric segment can be defined as the basic **electric action potential** with the current unit of **1 ampere**:

$$1 \; E_{A,electric} = 1 \; ampere = 1[\mathrm{Js}] \; =$$

$$= \mathrm{SP(A)}[2d\text{-}space] \; f = \mathrm{SP(A)} = 1 \qquad (95)$$

In this case, $[2d\text{-}space] = (\Delta l/R)^2 = (1\ \mathrm{m}^2/1\ \mathrm{m}^2) = \mathrm{SP(A)} = 1$ and $f = 1\ \mathrm{s}^{-1} = \mathrm{SP(A)} = 1$. The current definition of ampere is an arbitrary decision with respect to the SI system and can be substituted by any other definition and system of reference. It is important to observe that this definition is **independent** of the wire material - it holds in any kind of conductor. This reveals the *a priori* mathematical character of this definition, which can be confirmed by an experiment in a secondary manner.

This definition is based on the assumption that the „parallel axiom“ of geometry is correct. However, this axiom could not be proven so far. We have shown that any motion of space-time is rotation because space-time is a closed entity. This property of space-time is manifested by all systems - it is a fundamental „proof of existence“ that there are no straight paths or parallel wires in space-time. The parallel axiom is an erroneous concept of geometry and should be eliminated once and for all.

For instance, this conclusion can be deduced from the general theory of relativity, which assumes that space-time is bent by gravitation, so that the path of light cannot be a straight line. The closed character of space-time and its subsets also becomes evident when we consider the fact that the two electric segments either attract or repel. When this motion is considered, it becomes evident that the two wires cannot remain parallel to each other in infinity. The notion of parallel straight lines in geometry is an N-set (closed system). As systems are open, they exchange energy and either expand (repulsion) or contract (attraction). The manifestation of this energy exchange is a superimposed rotation. This follows from the reciprocity of space and time.

If we now present the conventional definition of the electric current $I = \Delta Q/\Delta t$ in the new space-symbolism and solve it for the **charge *Q*:**

$$Q = I\Delta t = \mathrm{SP(A)}[2d\text{-}space]\ f\,/f =$$

$$= \mathrm{SP(A)}[2d\text{-}space] = K_s = area \qquad (96),$$

we come to the conclusion that this quantity is a **pleonasm for geometric area** (K_s). Equation (96) demonstrates the inner consistency and transitiveness of the new axiomatics for any conventionally defined quantity of space-time. However, this formula is incomplete - it does not include the cross-sectional area *A*. When we consider this quantity (93), we arrive at the following consistent definition of charge:

> **Charge** is a two-dimensional quantity of space SP(A)[2*d*-*space*], which is obtained in relation to a well defined area according to PCA, usually as a *cross-sectional area* of the conductor:

$$I\Delta t = \frac{\Delta Q}{A} = \frac{area_Q}{area_{reference}} = \mathrm{SP(A)}\left[2d - space\right] = K_s \qquad (96a)$$

When we compare two [2*d*-*space*]-quantities, we can either write SP(A)[2*d*-*space*] or SP(A) for the comparison. For instance, the area of a soccer field is a ratio to the arbitrary unit area of 1 m^2, which can either be expressed as a number SP(A) = n = 5 000 in mathematics or an area SP(A)[2*d*-*space*] = 5 000 m^2 in geometry. In equation (96a), the cross-sectional area is the reference magnitude that can be easily determined. The actual area of the „charges in motion" is practically not known. It is obtained in relation to the cross-sectional area of the conductor, which we can precisely measure (PCA). Thus the measurement of the electric current, which is an action potential of the observed electric space-time, is, in reality, an indirect measurement of the **area of the particles in motion**. These can be electrons, protons, ions, or macroscopic assemblies of particles, such as solenoids of electric generators, motors, or transformers. These devices can only operate when they are in a circular motion. When there is no motion, that is, when no charge (area) flows, there is no current and no visible energy interaction. This holds true for the electric current, as well as for the water current - both are distinct sources of energy.

Based on the conventional definition, we have proved that charge is area. We shall now present some fundamental derivations of the Law that confirm this conclusion. These derivations are based on experimental results. As charge is area, we must automatically conclude that the SI unit *coulomb* is equivalent to the SI unit of square distance, m^2:

$$\mathbf{1\ C = 1\ m^2} \qquad (97)$$

This is a basic statement of the new axiomatics. As it is a self-consistent categorical system that lacks any contradictions, it would be sufficient to reject this simple equation to refute the whole axiomatics and the existence of the Law. However, this is not possible. Below, we shall prove that the equivalence between one coulomb and one square meter holds for the charge of the electron, which is defined as the **fundamental unit of charge** *e*, to which all other charges are conventionally compared $Q/e = f$. We begin with the evidence that the fundamental charge *e* is <u>not</u> the elementary area of space-time.

The Charge of the Basic Photon q_p is the Elementary Area (K_s) of Space-Time

The charge (area) q_p of the basic photon is the elementary area (K_s) that builds the charge (area) e of the electron (inhomogeneity of the electric structure). This idea is basic to **Bohr model** of energy quantization of the hydrogen atom (5.1). The mass of the electron can be expressed as a discrete U-set of the mass of the basic photon $m_e = m_p f_{c,e}$ (45). As mass is a space-time relationship, the same relation should also hold for the structural complexity of these two systems, which are elementary action potentials of the electric and photon levels. The **charge (area) of the basic photon** q_p is a new fundamental constant that can be obtained from the charge of the electron e ($f_{c,e} = c/\lambda_{c,e}$ is called **Compton frequency**):

$$q_p = \frac{e}{f_{c,e}} = 1.29669 \times 10^{-39} [\mathrm{C} = \mathrm{m}^2] \tag{98}$$

The charge of the basic photon can be regarded as the most **elementary area of space-time** which we can measure or calculate at present. We shall now perform a collection of derivations within mathematical formalism that will anticipate some basic quantities and equations of electricity. We can imagine q_p as the cross-sectional area of the basic photon when the latter is considered a transversal electromagnetic wave that is propagated with the speed c. The square speed of light is defined as the universal potential of photon space-time $LRC = U_U = c^2$. In electricity, the electric energy is defined as the product of charge and electric potential $E = QU = \mathrm{SP(A)}[2d\text{-}space\text{-}time]$ (4.7). This equation is an iteration of UE. We can now use this equation for the basic photon to obtain its **electric energy** and **structural complexity** K_s:

$$E = q_p U_U = q_p c^2 = q_p \lambda_A{}^2 = K_s = \mathrm{SP(A)}[2d\text{-}space] =$$

$$= 11.654 \times 10^{-23}\ \mathrm{m}^2, \text{ as } f_p = 1 \tag{99}$$

In terms of electricity, photon space-time can be regarded as an **electric current** with the **voltage** of $U_U = c^2 \cong 9 \times 10^{16}$ [V = $\mathrm{m}^2\mathrm{s}^{-2}$] (see equivalence between SI units in 4.7). In this sense, the structural complexity of the basic photon can be presented as an area integral of the basic

photon when it is considered a standing wave with the wavelength of $\lambda_A \cong 3\times10^8$ m. This quantity is obtained within geometry and can be replaced by any other quantity of area. We use this quantity because it is basic to the conventional geometric derivation of some important quantities of magnetism, such as **Bohr magneton**:

$$m_B = \frac{e\hbar}{2m_e} = \frac{q_p\lambda_A{}^2}{4\pi} = circle-area = \frac{circumference^2}{4\pi} =$$

$$= \frac{A^2}{4\pi} = 9.274\times10^{-24}\,\mathrm{m}^2 \qquad (100)$$

In this case, $q_p\lambda_A{}^2 = \mathrm{SP(A)} \times (3\times10^8)^2\ \mathrm{m}^2 = K_s$ is square circumference and Bohr magneton is defined as the area of a circle. We shall show below that this circle is attributed to the electron. From Bohr magneton, the **atomic magnetic moments** are derived in magnetism of matter (4.12). Equation (100) confirms that any traditional quantity of material particles can only be defined in relation to the space-time of the photon level, in most cases to the space-time of the basic photon. Bohr magneton is a fundamental constant (area), from which the **magnetic moments** (areas) of the elementary particles are obtained within mathematical formalism and subsequently confirmed in experiments (see Table 1). Thus equations (98) to (100) include the derivation of **five** basic constants of physics from the new constant, the charge (area) of the basic photon q_p, by employing UE: 1) the **fundamental unit of charge** e; 2) **Bohr magneton** m_B; the **magnetic moments** of 3) electron m_e, 4) proton m_{pr}, and 5) neutron m_n. This result illustrates the unity of space-time. It also reveals that physics is geometry and mathematics applied to the physical world.

In Bohr magneton (100), the wavelength λ_A of the basic photon is intuitively assessed as a circumference. This seems logical when one recalls that each wave is a product of rotation. As all motions are rotations, any distance, which we define as a [1*d-space*]-quantity, is in fact a closed line that can be ideally expressed as the circumference of a circular motion. We have met this approach in Kepler's third law. It is, indeed, very common in physics. Particularly in electromagnetism, it leads to the definition of magnetic moments. As any straight line is a section of a circumference when it is assigned to real space-time, we can describe any amplitude A (maximal expansion) of a wave as a circumference: the

square circumference is thus an abstract [2*d-space*]-quantity, called „**charge**“. This is the degree of freedom of mathematical consciousness. This approach is the actual method of definition of the *fundamental unit of charge e*. Geometry is the hidden method of definition of this basic constant of electricity.

The Fundamental Unit of Charge *e* is the Geometric Area of the Electron

In equation (100), the structural complexity of the basic photon $K_s = q_p\lambda_A{}^2$ is presented as **square circumference** A^2. This geometric quantity assesses the maximal extension of this system of space-time in terms of area. This is simple geometry applied to the real world. Although this fact has not been realized by physicists so far, the same mathematical approach has been used to assess the structural complexity of the electron.

In order to unveil this hidden definition, we must depart from the **Pauli exclusion principle** (**Pauli-Verbot**). It postulates that no two electrons of an atom can acquire the same quantum condition that is determined by the four quantum numbers, n, l, m, and m_s. These numbers are believed to describe the spatial configuration of the electrons in the atom. In fact, Pauli principle is an interpretation of Schrödinger wave equation of quantum mechanics as presented in **Fermi-Dirac statistics.** According to it, all **fermions** (e.g. electrons, protons, and neutrons) have an **asymmetric function** $\psi(x_2, x_1) = -\psi(x_1, x_2)$, that is, they have a **half-integral spin** and obey the exclusion principle, while all **bosons** (e.g. photons) have a **symmetric function**.

What is the vested knowledge behind such iterative definitions within mathematics? We shall explain this for the basic photon and electron. The basic photon (h) is regarded as a **transversal harmonic wave** that results from a circular motion. Although the actual sources of this circular motion are not an object of study in modern physics, the basic photon is actually regarded as a **sphere** with the square circumference of $K_s = q_p\lambda_A{}^2 = A^2$ (equation (99) & (100)). According to Pauli exclusion principle[29], the electron is considered a **standing asymmetric wave** that

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[29] It is important to observe that all basic concepts in quantum mechanics are of geometric origin, even when they are presented in terms of statistics. The reason for this is that the statistical magnitudes obtained from statistical tests are either space or time quantities. As time is reciprocal space, all mathematical evaluations in quantum statistics end up in geometric presentations.

acquires the form of a **hemisphere** with the **surface area** S_e of

$$K_{s,e} = S_e = S_0/2 = \pi d^{\,2}/2 \qquad (101),$$

where S_0 is the area of the sphere and d is the diameter. If we set the Compton wavelength of the electron $\lambda_{c,e}$, which is [1*d-space*]-quantity of this system, equal to the hypothetical diameter of the electron, we obtain for the **area** of the **electron hemisphere** a value that is almost equal to that of Bohr magneton (100):

$$S_e = 0.5S_0 = 0.5\pi d^{\,2} = 0.5\pi\lambda_{c,e}{}^2 = 9.247 \times 10^{-24}\ \mathrm{m}^2 \cong$$

$$\cong m_B = 9.274 \times 10^{-24}\ \mathrm{m}^2 \qquad (102)$$

The small difference results from the fact that real systems are open and cannot have the form of ideal spheres, which are abstract closed systems. From the equivalence between the area of the electron hemisphere (102) and Bohr magneton (100) $S_e = m_B$, we obtain the following equation (see also equation (98)):

$$\frac{q_p\lambda_A{}^2}{4\pi} = \frac{e}{f_{c,e}} \times \frac{\lambda_A{}^2}{4\pi} = \frac{\pi\lambda_{c,e}{}^2}{2} \qquad (103)$$

When we solve this equation for the **fundamental unit of charge *e***:

$$e = 2\pi^2 f_{c,e}\left[\frac{\lambda_{c,e}}{\lambda_A}\right]^2 = \mathrm{SP(A)}[2d - space] = K_s = 1.6\times10^{-19}\,\mathrm{m}^2 \qquad (104),$$

we obtain $\boldsymbol{K_s}$ **of the electron** in relation to K_s of the basic photon as a reference area (PCA). We conclude:

> The *fundamental unit of charge e* is **area** $e = 1.6\times10^{-19}$ m^2.
> The SI unit of charge **coulomb** is identical to the SI unit of space *meter*^{2}: **1 C = 1 m^2.**

This explains why coulomb is considered a very big unit when applied to particles[30]. This new insight effects probably the greatest simplification of our physical outlook, not only from a theoretical point of view[31], but also from a practical point of view, as many motors and machines used in daily life are electrically driven. At the same time, it reveals the most awkward mistake of physics - its decision to introduce the word „charge" as a pleonasm for „geometric area" without realizing the epistemological background of this fundamental quantity of electricity. Thus electricity and electromagnetism appear to be **applied geometry** to the electromagnetic level(s) of space-time - they are simple studies of the electric form (structural complexity).

4.3 WHAT ARE PERMETTIVITY AND PERMEABILITY OF FREE SPACE (ND)?

Before we discuss the *laws of electricity* and *magnetism*, we must first explain the epistemological background of the two fundamental constants, **permettivity of free space ε_0**, and **permeability of free space μ_0**, as they appear in the equations of these laws. The two constants are experimentally obtained, but physics is unable to explain their meaning. Conventionally, they are described as „material constants of vacuum". The term „free space" reveals that space (extent) is considered „free of energy", that is, vacuum (N-set). Unfortunately, electromagnetism gives no explanation as to how the void can exhibit constant material magnitudes that can be experimentally measured - the two constants, ε_0 and μ_0, are part of physical laws which are employed to measure electromagnetic interactions of matter. This observation discloses the profound confusion in this discipline.

We shall prove that the two constants are **quantities of photon space-time**, which are used as a reference frame in electromagne-

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30 Kane & Sternheim, Physics, Chapter 16.

31 The knowledge that charge is area is very useful in explaining the charges of quarks, which are fractions of *e*. Within the new axiomatics, I have developed an elegant model which explains the fractional charges (areas) of quarks in a simple way. Until now, this fact could not be explained by QCD. Thus, the new interpretation of the quantity „charge" has a fundamental theoretical impact not only on electromagnetism, but also on QED and QCD.

tism to measure the space-time of material electric systems according to PCA. For this purpose, we depart from the famous Maxwell's equation of electromagnetism that associates these constants with the speed of light $c = 1/\sqrt{\mu_0\varepsilon_0}$. The speed of light is a one-dimensional quantity of the space-time of the photon level. When this quantity is expressed as *LRC*, we obtain:

$$c^2 = LRC = U_U = \frac{1}{\mu_0\varepsilon_0} = \left[2d - space - time\right]_p \tag{105}$$

or

$$c^2\mu_0\varepsilon_0 = \frac{c^2}{\left[2d - space - time\right]_p} = 1 = certain\ event \tag{105a}$$

Maxwell's equation is basic to his four equations of electromagnetism. It is an application of UE for the photon level: when photon space-time is compared with itself, we obtain the certain event SP(A) = 1. This equation stems from the mind and can be confirmed experimentally in a secondary manner.

The dimensionality of the two constants can be easily obtained when we consider their method of definition and measurement. For this purpose we take the basic law of electricity, Coulomb's law; the other laws of electromagnetism are mathematical derivations from this law. In it, the **Coulomb constant** *k* is given in relation to the permettivity of free space ε_0: $k = 1/4\pi\varepsilon_0 = \text{SP(A)}\varepsilon_0$ according to PCA. The method of definition is geometry (36). This means that ε_0 has the same dimensionality as Coulomb constant, while this constant is defined in the same way as the universal gravitational constant $G = [1d\text{-}space\text{-}time]\ f$ (35). This follows from the identical method (AR) used to express Newton's law of gravity and Coulomb's law of electricity. Both are derivations of the Law and can be ontologically derived from our mathematical consciousness (see 1.7). Another reason for this equivalent mathematical expression of the two laws is that the basic quantities, charge and mass, are defined in a static way $m,\ q \Rightarrow K_s = \text{SP(A)}[2d\text{-}space] = \text{SP(A)}$, when $f = 1$ and $[2d\text{-}space] = 1$:

$$F = G\frac{m_1 m_2}{r^2} \Leftrightarrow k\frac{q_1 q_2}{r^2} = \frac{1}{4\pi\varepsilon_0}\frac{q}{r^2} = \frac{1}{4\pi\varepsilon_0} \times \frac{\mathrm{SP(A)}[2d - space]}{[2d - space]} =$$

$$= \frac{1}{4\pi\varepsilon_0}\mathrm{SP(A)} \qquad (106),$$

where $q_1 q_2 = q$ (AR)[32]. When we solve this equation for the reciprocal value of the **permettivity of free space** $1/\varepsilon_0$, we obtain the actual dimensionality of this constant:

$$\frac{1}{\varepsilon_0} = \frac{4\pi F}{\mathrm{SP(A)}} = \frac{\mathrm{SP(A)}[1d - space - time]f}{\mathrm{SP(A)}} =$$

$$= [1d - space - time]f = a \qquad (106a),$$

as $4\pi\mathrm{SP(A)} = \mathrm{SP(A)}$: **$1/\varepsilon_0$ is acceleration** (3) as G. This quantity of space-time is usually given as a specific constant for each particular system, for instance, as g for the earth's gravitation. In electricity, this quantity is introduced analogously to the gravitational acceleration $g = F/m = F/\mathrm{SP(A)}$:

> „The electric force exerted by one charge on another is an example of an action-at-a-distance force that is similar to the gravitational force exerted by one mass on another. To avoid the problem of action at a distance, we introduce the concept of electric field E. One charge produces an electric field E everywhere, and this field exerts the force on the other charge...The electric field E at a point is defined as the net force on a positive test charge q_0 divided by q_0:"

$$\mathsf{E}_0 = \frac{F}{q_0} = \frac{\mathrm{SP(A)}[1d - space - time]f}{\mathrm{SP(A)}} =$$

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[32] AR acquires a simple form in geometry: for instance, the product of two areas is also area: 1 $m^2 \times 10\ m^2 = 10\ m^2$.

$$= [1d - space - time]f = a = \frac{1}{\varepsilon_0} \tag{107}$$

The definition of the **electric field $\mathbf{E_0}$** is a circular definition that departs from Coulomb's law of the electric force (4.4). It introduces the new quantity „electric field" as a pleonasm of the quantity „acceleration", which is reciprocal permettivity of free space$1/\varepsilon_0$: $\mathbf{E_0} = 1/\varepsilon_0$. This quantity assesses photon space-time. This is also evident from Maxwell's equation of the speed of light $c = 1/\sqrt{\mu_0\varepsilon_0}$.

In mechanics, the mean acceleration of the gravitational photon level which is a U-subset of photon space-time is called „universal gravitational constant" $G = g_U$(35). At present, the two constants, E_0 and G, are believed to be distinct quantities. This hinders the integration of gravitation with electromagnetism. In fact, the two constants, $E_0 = 1/\varepsilon_0 = \mu_0 c^2$ (105) and $G = c^3/E_{AU}$ (29), or $G = c^2/S_U$ (37) are abstract U-subsets of photon space-time defined within mathematics - they are interrelated through c, which is a [1*d-space-time*]-quantity of the photon level. We have proved this by deriving Newton's law of gravity from UE (28). This example brings into a focus the cognitive mess of modern physics. We conclude:

> The **electromagnetic photon level** and the **gravitational photon level** are defined in conventional physics as **geometric U-subsets** of the **photon level**.

The latter can be regarded as the aggregated set of these levels, as well as of all those levels to which we have no access at present. This is also true for the magnetic level as part of the electromagnetic photon level (see below). The difference between these levels of photon space-time is not of real character, but is introduced through their method of definition, which is geometry. It is also the method of measurement of their basic constants, G and E_0. This is a clear-cut explanation of the etymological origin of electromagnetism and gravitation.

The mathematical (geometric) background of the electric quantities of electromagnetism becomes evident when we analyse how **Coulomb constant** is obtained from the permettivity of free space (see also equation (36)):

$$k = \frac{1}{4\pi\varepsilon_0} = \frac{\mathsf{E}_0}{4\pi} = \frac{acceleration}{4\pi} = circle - area = \frac{circumference^2}{4\pi} =$$

$$= A = \frac{u^2}{4\pi} \tag{108}$$

In the new axiomatics, we define the **reciprocal permettivity of free space:**

$$1/\varepsilon_0 = \mathsf{E}_0 = [1d\text{-}space\text{-}time]\, f = 0.11294 \times 10^{12}\ \mathrm{ms}^{-2} \tag{109}$$

as the **universal quantity** of the electric photon level, which is conventionally used as a reference frame in electromagnetism. We also call this quantity the „**electric field**" or „**electric acceleration**" of photon space-time.

When we set the dimensionality of the electric field of photon space-time in Maxwell's equation, we obtain for the reciprocal value of the **permeability of free space $1/\mu_0$** the dimensionality of a **distance** ([1*d-space*]):

$$\frac{1}{\mu_0} = l_{\mu_0} = \frac{c^2}{\mathsf{E}_0} = \frac{[2d - space - time]}{[1d - space - time]f} =$$

$$= [1d - space] = 0.795775 \times 10^6\,\mathrm{m} \tag{110}$$

We call this **new** fundamental constant of electromagnetism the **magnetic field length $l_{\mu 0}$** of photon space-time. It plays an important role in the new theory of cosmology based on the Law (see 7.9).

4.4 COULOMB'S LAW AND THE ELECTRIC FIELD

Coulomb's law assesses an interaction between two static charges within geometry by applying AR:

$$F_{12} = k\frac{q_1 q_2}{r_{12}^{\,2}}\mathsf{r}_{12} = \frac{\mathsf{E}_0 q_1 q_2}{4\pi r_{12}^{\,2}} = \frac{\mathsf{E}_0 q_1 q_2}{spherical-area} =$$

$$= \mathrm{SP(A)}\left[1d-space-time\right]f \qquad (111),$$

where $\mathsf{r}_{12} = \mathbf{r}_{12}/r_{12} = \mathrm{SP(A)} = n$ is defined as a unit vector pointing from q_1 to q_2; $q_1 q_2 = q = \mathrm{SP(A)}[2d\text{-}space]$ (AR). The geometric approach is cogent. The photon system enclosed by the two charges is regarded as a sphere with the area of $A = 4\pi r^2$. This [2*d*-*space*]-quantity can be measured. The energy interaction between the two charges can be either attraction (opposite signs of the charges) or repulsion (charges have the same charge). The positive and negative signs attributed to charges represent a mathematical convention that gives the conditions of the constructive or destructive interference of waves. Both phenomena are a manifestation of the reciprocity of space and time (1.6). The motion of material charges is mediated through the photon system that is confined by the two charges. The two material systems (recall that all systems of matter have a charge) enter into a vertical energy exchange with the photon system to exert a horizontal energy exchange as assessed by **Coulomb force** (111).

Coulomb's law involves the space-time of the photon system as a reference frame. This becomes evident when we solve equation (111) for the electric field. If we regard q_2 as a test charge q_0, that is, if we set $q_0 = 1$, we obtain from Coulomb force the electric field of the charge q_1: $\mathsf{E}_1 = F_{12}/q_2$ or $F_{12} = \mathsf{E}_1 q_2$. If we now substitute the force in *Coulomb's law* with this term and rearrange it, we obtain UE as an RT:

$$\frac{\mathsf{E}_1}{\mathsf{E}_0} = \frac{q_1}{A} = \frac{\mathrm{SP(A)}\left[2d-space\right]_1}{\mathrm{SP(A)}\left[2d-space\right]_R} = \mathrm{SP(A)} = K_{1,R} \qquad (111a),$$

where $A = 4\pi r_{12}^{\,2}$ is the **reference area**. Coulomb's law is a simple comparison of space magnitudes within geometry (method of definition and measurement). Equation (111a) illuminates the cognitive mess in electricity as a discipline. The charge q_1 is regarded as a point, that is, it should have no volume or surface. As charge is area, q_1 is zero. In this case, the ratio q_1/A is also zero $0/A = 0$. This equation is meaningless - in practice, Coulomb law would always render zero values for any charge

interaction, if we assume that charges are spaceless points. This is a typical example of the theoretical problems which always emerge when mathematics is applied to the physical world without comprehending its cognitive background.

Like any other application of the Law, Coulomb's law assesses the interaction between the charges according to AR: $F_{12} = \mathsf{E}_1 q_2$, by setting the electric field (acceleration) E_1 for the first entity q_1 and the charge q_2 for the second entity. This presentation is borrowed from classical mechanics, where the earth's space-time is given as gravitational acceleration g and the space-time of the object as mass $m = K_s = \text{SP(A)}[2d\text{-}space] = \text{SP(A)}$. This results in Newton's second law $F = mg$. The space-time of the resultant system given by F is then compared to the space-time of the photon level given by $G = g_U$, which is acceleration (29). This mathematical operation according to AR produces Newton's law of gravity (27). This law is a comparison between the space-time of the resultant gravitational system and the space-time of the photon level in terms of acceleration (as given for the earth, M is the earth's mass):

$$g = G\frac{M}{r^2} = g_U \frac{\text{SP(A)}[2d - space]}{[2d - space]} = g_U \text{SP(A)}$$

or

$$\frac{g}{g_U} = \text{SP(A)} = K_{M,U} \tag{112}$$

> **Coulomb's law of electricity** and **Newton's law of gravity** are applications of the Law as an RT. They are defined according to AR. Both laws use **photon space-time** as a reference frame, to which any gravitational or electric system is compared within mathematics according to PCA. Hence the equivalent mathematical expression of the two laws.

Both are **inverse-square laws.** For instance, Newton's law of gravity is also called "inverse-square law of gravity". It has been established that many natural laws are inverse-square laws. There is nothing mystical about this mathematical presentation - it is not a property of nature, as is generally believed, but a simple geometric formalism introduced by man

in physics. The inverse square distance is actually the **area** that is obtained within mathematics when the space-time of any two interacting entities, which are regarded as mass points or charge points ($K_s = 0$), is described as vectors, $[1d\text{-}space]_1$ and $[1d\text{-}space]_2$, in empty Euclidean space. The space-time of the resultant system is then expressed as an area when AR is applied:

$$E = 1/[1d\text{-}space]_1 \times 1/[1d\text{-}space]_2 =$$

$$=1/[2d\text{-}space] = 1/r^2 \Rightarrow \textbf{inverse-square laws} \qquad (113)$$

The inverse-square laws are applications of the Law - they assess the reciprocity of energy and space, respectively, of space and time $E \approx f = 1/[2d\text{-}space]$.

Coulomb's law is a static assessment of the electric space-time in terms of space (charge or area). Many terms and quantities that play a major role not only in physics, but also in chemistry and related disciplines, such as biochemistry, pharmacology, and other bio-sciences, are introduced through this law. For instance, a system of two equal and opposite charges q separated by a small distance L is called an **electric dipole.** This system can be a molecule or a macroscopic material system:

$$p = qL = \text{SP(A)}[2d\text{-}space] \qquad (114)$$

When $q = \text{SP(A)}$ and $L = [1d\text{-}space]$, then $p = qL = \text{SP(A)}[2d\text{-}space] = \text{SP(A)}[1d\text{-}space]$ (PLE). This presentation is important for an understanding of the concept of **electric-field lines,** which is basic to the derivation of Gauss's law (4.5).

4.5 GAUSS'S LAW AND ITS APPLICATIONS

Just as we set mass in relation to volume to obtain mass density (47), we can set the charge (area) of the electric systems in relation to the volume of the corresponding photon system and obtain the **volume charge density**:

$$\rho = \frac{\Delta Q}{\Delta V} = \frac{\text{SP(A)}[2d - space]}{[3d - space]} = \frac{\text{SP(A)}}{[1d - space]} \qquad (115),$$

the **surface charge density**:

$$\sigma = \frac{\Delta Q}{\Delta A} = \frac{\mathrm{SP(A)}[2d - space]}{[2d - space]} = \mathrm{SP(A)} \qquad (116),$$

or the **linear charge density** (see also the quantity mass per unit length μ in (54)):

$$\lambda = \frac{\Delta Q}{\Delta L} = \frac{\mathrm{SP(A)}}{[1d - space]} \qquad (117)$$

This is applied geometry that forms the basis of **classical electrostatics**. These quantities appear again in electromagnetism, however expressed in a different mathematical form (4.13). The **electric field** is conventionally obtained from Coulomb's law in the following manner:

$$\mathsf{E} = \int_V \frac{kdq}{r^2}\hat{\mathsf{r}} = [1d - space - time]f \qquad (118)$$

This confirms the transitiveness of the new axiomatics, which is based on mathematics. The extensive use of geometry in electricity has led to a novel derivation of Coulomb's law, called **Gauss's law,** by introducing the new quantity **electric flux** ϕ. This application of UE allows the qualitative description of the electric field on a closed surface related to the net charge (area) within the surface by using the concept of electric-field lines. For this purpose the **electric flux** is defined as the product of the field E and the area A that is cross-sectional (perpendicular) to its electric-field lines (AR):

$$\phi = \mathsf{E}A = [1d\text{-}space\text{-}time]\, f \times [2d\text{-}space] =$$

$$= [2d\text{-}space\text{-}time][1d\text{-}space] \qquad (119)$$

Usually, this equation is given in the integral form for the **net flux** through a closed surface:

$$\phi_{net} = \oint_S \mathsf{E}_n dA = \mathrm{SP(A)}[2d - space - time][1d\text{-}space] = Es = E_A \mathsf{v}$$

$$\text{and } E = E_A \mathsf{v}/\mathrm{s} = E_A f \qquad (119a),$$

where SP(A) stands for integration. Gauss's law is an application of UE. There are various derivations of Gauss's law, which illustrate the common origin of this law from Coulomb's law, that is, from UE. A common geometric formula is the one that assesses the net flux through any surface with respect to the net charge (area) inside Q_{inside}:

$$\phi_{net} = \oint_S \mathsf{E}_n dA = 4\pi k Q_{inside} = \frac{1}{\varepsilon_0} Q_{inside} = \mathsf{E}_0 Q_{inside} = Es = E_A \mathsf{v} \qquad (119b)$$

Gauss's law is used for the qualitative evaluation of the electric charge (area) within a closed photon system in relation to an arbitrarily defined surface of this system, which is usually considered to be a closed area. Thus Gauss's law is not a distinct law, but a geometric iteration of Coulomb's law.

4.6 NABLA AND LAPLACE OPERATORS

To understand electromagnetism, we must introduce an important application of differential calculus in physics and discuss it in the light of the Law. Differential calculus was invented by Newton and Leibniz to assess instantaneous velocity from its constituents, space and time. The differential method is also used for the derivation of the classical wave function (61), which is basic to Maxwell's equations of electromagnetism (4.13 & 4.14) and to Schrödinger wave equation of quantum mechanics (5.2). The differential calculus involves the two constituents. For instance, the quantity acceleration or electric field is the first derivative of velocity with respect to time ($f = 1/dt$): a, $\mathsf{E} = \mathrm{dv}/dt = [1d\text{-}space\text{-}time]\, f$. The differential method can be applied to space too, for instance we can obtain the force from the potential energy as follows: $F_x = dE_{pot}/dx$. In this case, the force is usually called the „negative derivative" of the potential energy with respect to the distance x given as a space vector. The opposite operation is the integration of the instantaneous force F_x along the distance x. It renders the energy as two-dimensional space-time. For

this reason, Newton's three laws can be presented as energy laws. Due to the common paradigm of geometric expression in physics, any energy interaction between two entities results in a two-dimensional expression of space-time E = SP(A)[2*d-space-time*]. This allows **two** concrete applications of differential calculus in physics that have not been clarified from a cognitive point of view.

When space-time is regarded statically as LRC = [2*d-space-time*] = E_{pot}, we can obtain the force by building the negative derivative of this quantity with respect to space, which is given as a distance [1*d-space*]. This specific application of differential calculus is called „**building of gradients**":

$$F = -gradE_{pot} = -\left(\frac{\partial E_{pot}}{\partial x}, \frac{\partial E_{pot}}{\partial y}, \frac{\partial E_{pot}}{\partial z}\right) \tag{120}$$

In this sense, the term „gradient" is a synonym for force. The minus sign is a mathematical convention and can be omitted. Like the force, the gradient is conventionally defined as a vector, while the $LRC = E_{pot}$, which is initially called a gradient, is considered to be a scalar. This is a pure convention of geometry without any cognitive relevance.

The operation of „gradient building" is broadly used in physics. When it is applied to three-dimensional Euclidean space, the standard procedure (d/dx, d/dy, d/dz) is called **Nabla operator** and is presented with the symbol „∇„. We shall come across this operator in many electromagnetic equations. In terms of geometry, the Nabla operator renders a vector quantity (force) from a scalar quantity ($LRC = E_{pot}$). When we employ this operator for LRC, we acquire the **electric field** or **electric acceleration** as the negative derivative:

$$\mathsf{E} = grad\varphi = \nabla\varphi = \frac{d\varphi}{dr} = \frac{LRC}{r} = \frac{[2d - space - time]}{[1d - space]} =$$

$$= [1d - space - time]f \tag{121}$$

Equation (121) illustrates the significant simplification which the new space-time symbolism introduces in physics. In fact, it renders the new term Nabla operator (building of gradients) obsolete - it is a particular

application of differential calculus, and this operation has its origin in the Law. Differential calculus can be expressed much more simply in the new space-time symbolism.

The fact that we can obtain a scalar from a vector and vice versa within mathematics has not been fully apprehended so far, although many famous mathematicians and physicists, such as Weierstraß, Cayly, Gauß, and Hamilton, have worked on this problem. The knowledge that physics is applied mathematics and that all physical quantities are abstract terms of mathematics is an achievement of the present axiomatics. In the conventional view, these quantities are considered real properties of the physical world. Therefore, for the purpose of „symmetry", it seems quite logical to develop the opposite operation, with which a scalar can be obtained from a vector. This has led to the introduction of **Laplace operator** symbolized with „Δ„ = *div* for the *LRC* or *div*(*grad*) for the first negative derivative. This symbol should not be confused with the same symbol used for the difference in a quantity, e.g. Δ*x* (ambiguity of mathematical symbolism). This sign is also called „divergence". The mathematical operation of **divergence** is given as:

$$div(\,grad\,)a = \Delta\varphi = \left(\frac{\partial^2}{\partial^2 x}, \frac{\partial^2}{\partial^2 y}, \frac{\partial^2}{\partial^2 z}\right) \qquad (122),$$

where $\varphi = LRC = U$ is another expression of the energy gradient. The operation of divergence is actually the building of the second negative derivative from *LRC* with respect to space. This results in **square time**:

$$div(\,grad\,)a = \Delta\varphi = \frac{d^2\varphi}{d^2 r} = \frac{LRC}{r^2} = \frac{[2d - space - time]}{[2d - space]} =$$

$$= f^2 = \mathrm{SP(A)} \qquad (123)$$

There are many quantities in physics that have the dimensionality of square time, for instance, **Einstein's cosmological constant**. This quantity results from the two-dimensional presentation of space-time within geometry according to AR (see 7.3). The transformation of differential calculus into the new space-time symbolism follows a simple **rule of differentiation**:

In **equations of divergence**, the differential sign d^2 in the numerator expresses the absolute time $d^2 = f^2$. When the same sign appears in the denominator, it stands for [2*d-space*]: $1/d^2 = 1/[2d\text{-}space]$. This also applies to **equations of gradient building**. In this case, we set $d = f$ in the numerator and $1/d = 1/[1d\text{-}space]$ in the denominator.

The operation of divergence is not applied in a consistent way in electromagnetism. This creates some confusion with respect to the actual dimensionality of the quantities which are introduced by this method. We shall illustrate this problem with a common presentation of the electric field called **Poisson-equation:**

$$div\ \mathsf{E} = \Delta\varphi = \rho/\varepsilon_0 \qquad (124),$$

where ρ is the volume charge density (115). In this expression, "*div*" is written for divergence "Δ" with respect to the electric charge, although the correct writing should be *div*(*grad*). From a formalistic point of view, the operation of divergence should only be applied to the $LRC = \varphi$ because it is the differential calculation of the second negative derivative for space $1/[2d\text{-}space]$, while the electric field is a one-dimensional quantity of space-time. As long as both expressions are written together, the equivalence between the two different expressions is cogent. However, a problem emerges when the first expression stands alone, for instance, when Gauss's law is given in the integral form (119):

$$\phi_{net} = \oint_S \mathsf{E}_n dA = \oint_V div\mathsf{E} dV = \mathrm{SP(A)}\left[2d - space - time\right] = E \qquad (125),$$

in which case we obtain for the net flux the dimensionality of energy $E = \mathrm{SP(A)}[2d\text{-}space\text{-}time]$. The actual dimensionality is, however:

$$\phi_{net} = \oint_V div\mathsf{E} dV = \int_V \Delta\varphi dV =$$

$$= \mathrm{SP(A)}\left[2d - space - time\right] \times \left[1d - space\right] = Es \qquad (125a),$$

as presented in (119a) & (119b). The differential calculus of gradient building and divergence can be simply expressed in the new space-time symbolism:

1. **Gradient building**: $\nabla\, LRC = LRC \times 1/[1d\text{-}space] = \mathsf{E}$ or a, g (Instead of *LRC*, we can set any other quantity.)

2. **Divergence:** $\Delta\, LRC = LRC \times 1/[2d\text{-}space] = f^{2}$. (This operation should be applied to *LRC*, although it holds for any other abstract quantity.)

4.7 ELECTRIC POTENTIAL

The **electric potential** ***V*** is a central quantity of electricity. It assesses the *LRC* of electric systems. This quantity is usually given as a **potential difference** of two static values $dV = V_1 - V_2$. This is a mathematical convention, as each of the static values must also be a difference. A further term of this quantity is the **gradient** expressed as φ or as a difference $d\varphi$. The definition of the electric potential departs from the primary term, which is regarded from a static point of view. The **potential-energy function** is given by the equation:

$$dU = Fdl = q_0 \mathsf{E} dl = \Delta U = U_b - U_a = \int_a^b q_o \mathsf{E} dl =$$

$$= \mathrm{SP(A)}[2d - space - time] \tag{126}$$

The electric potential is defined in a similar manner to the gravitational potential by building a quotient of the potential-energy function and the charge $K_s = \mathrm{SP(A)} = 1$ according to PCA:

$$dV = \frac{dU}{q_o} = \mathsf{E} dl = \Delta V = V_a - V_b = \frac{\Delta U}{q_o} = \int_a^b \mathsf{E} dl =$$

$$= [2d - space - time] \tag{127}$$

When we depart from (126) and (127), and the previous equations, we can build the following useful equivalences between basic SI units. These equivalences facilitate the transformation of conventional physical formulae into the new space-time symbolism:

$$1\ \mathrm{V} = 1\ \mathrm{J}/1\ \mathrm{C} = 1\ \mathrm{kgm^2s^{-2}/m^2} = 1\ \mathrm{kgs^{-2}} = 1\ \mathrm{m^2s^{-2}} \tag{128}$$

$$1\ \mathrm{N/C} = 1\ \mathrm{N/m^2} = 1\ \mathrm{V/m} = 1\ \mathrm{m^2s^{-2}/m} = 1\ \mathrm{ms^{-2}} \tag{128a}$$

$$1\ \mathrm{N} = 1\ \mathrm{kgms^{-2}} = 1\ \mathrm{m^3s^{-2}} \tag{128b}$$

$$1\ \mathrm{A} = 1\ \mathrm{C}/1\ \mathrm{s} = 1\ \mathrm{m^2s^{-1}} \tag{128c}$$

As already proven, the basic SI units, volt, coulomb, and ampere of electricity, newton and kilogram in classical mechanics, and joule in thermodynamics, can be obtained from the two basic SI units, meter and second, of the constituents, space and time. This **equivalence of the SI units** is of great practical and cognitive importance. It simplifies advanced physics to the level of basic mathematics as taught in secondary schools.

4.8 CAPACITANCE, DIELECTRICS, AND ELECTROSTATIC ENERGY

Capacitors are useful devices for storing energy. This kind of K_s is also basic to the evolution of organic life. The cell membrane can be roughly regarded as a **closed, spherical parallel-plate capacitor**. The stored energy on this lipid bilayer is defined as **membrane potential** and can be experimentally measured. The energy exchange of this electric potential is called „**action potential**“ in physiology. We have borrowed this term for the universal event of energy exchange. The reason for this decision is that the Law was first discovered in relation to cell metabolism, which is the basic energy exchange of organic matter. In this case, the cell is a system of the cellular level of space-time and the cellular action potential is the elementary energetic event of this level (see vol. III).

The capacitance is a quantity of electric space-time that is derived from the parallel-plate capacitor. The ratio between the charge on either plate Q and the potential established between the two plates V is conventionally defined as **capacitance**:

$$C = \frac{Q}{V} = \frac{\mathrm{SP(A)}[2d - space]}{[2d - space - time]} = \frac{\mathrm{SP(A)}}{f^2} = \frac{1}{f^2},$$

$$\text{when SP(A)} = 1 \tag{129}$$

The capacitance is **reciprocal square time** with the actual unit of:

$$1\ farad = 1\ s^{-2} \tag{130}$$

This unit is too big for the purposes of electricity. We met the same problem with the unit "coulomb". Therefore, the commonly used units of capacitance are "microfarad" 1 μF and "picofarad" 1 pF. The method of measurement of capacitance is a hidden definition of the basic electric constant of photon space-time: the permettivity of free space ε_0. The reciprocal value of this constant is defined as the „electric field" E_0 of photon space-time (4.3):

$$C = \frac{Q}{V} = \frac{\varepsilon_0 A}{s},$$

hence:

$$\mathsf{E}_0 = \frac{A}{sC} = \frac{[2d-space]f^2}{[1d-space]} = [1d-space-time]f = a,g \tag{131}$$

This equation confirms that any method of measurement of a quantity is also the method of its definition.

In electricity, one distinguishes between **conductors** and **dielectrics** (non-conducting materials). This discrimination is arbitrary - the boundary is fluent. The evaluation of the dielectric properties of materials is based on the taciturn acknowledgement that all systems of space-time are U-sets that contain themselves as an element. We shall deduce this from the definition of the two basic dielectric quantities, **dielectric constant** *k* and **permittivity of the dielectric** $\varepsilon = 1/\mathsf{E}$:

> „If the original electric field between the plates of a capacitor without a dielectric is $\mathsf{E}_0 = 1/\varepsilon_0$, the field in the dielectric is $\mathsf{E} = \mathsf{E}_0/k$ "[33], hence $k = \mathsf{E}_0/\mathsf{E}$.
>
> The product of the dielectric constant *k* and the permettivity of free space ε_0 „is called the permettivity of the dielectric"[34]: $\varepsilon = k\varepsilon_0$.

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[33] PA Tipler, p. 695.
[34] PA Tipler, p. 695.

When we put the two definitions together, we obtain the Law as an RT:

$$k = \frac{\mathsf{E}_0}{\mathsf{E}} = \frac{\varepsilon}{\varepsilon_0} = \mathrm{SP(A)} = K_{1,2} \tag{132}$$

The quantity *dielectric constant k* is a dimensionless coefficient, also called an „**absolute constant of vertical energy exchange**". At present, „free space" is regarded as vacuum. However, it exhibits a quantity, the permettivity of free space, which is interpreted as a „material" constant, the actual magnitude of which can be experimentally determined (131). We are allowed to ask: „How can the void have a definite magnitude? And how can the free space produce a material constant if matter is regarded as an entity opposite to vacuum (free space)?" The absurdity of this view should be cogent to everybody.

The actual idea behind the aforementioned quantities is very simple. It intuitively considers the space which is enclosed between the two plates of the capacitor as a (die)electric system of photon space-time that is characterized by the universal electric quantity ε_0, which is the reciprocal acceleration of photon space-time (109). When there is a dielectric between the two plates, we can regard the system resulting from the photon system and the material system as the aggregated set (U-set) of the two interacting U-subsets, the common element of which is energy (space-time). We therefore apply PCA and compare the two systems in terms of the quantity electric field according to AR. This is the cognitive background of the concept of dielectrics (isolators) and their quantities, permettivity and dielectric constant.

The formulae used to determine the basic quantities of electricity, such as **electric energy *U***, **potential *V*, capacitance *C***, and **charge Q,** are briefly summarized:

$$U = \frac{1}{2}\frac{Q^2}{C} = \frac{1}{2}QV = \frac{1}{2}CV^2 = \mathrm{SP(A)}[2d - space - time] \tag{133}$$

They are iterations of well-known equations of classical mechanics assessing space-time. Finally, we introduce a basic quantity, which plays a major role in the derivation of the general wave equation of electromagnetism (4.14) and Schrödinger wave equation (5.2) - the so-called **energy density** η:

$$\eta = \frac{energy}{volume} = \frac{1}{2}\varepsilon E^2 = \frac{\mathrm{SP(A)}[2d - space - time]}{[3d - space]} = \frac{\mathrm{SP(A)}\, f^2}{[1d - space]} \quad (134)$$

This quantity is identical to tensile stress (48). It is of the same origin as density (47) and a number of similar quantities which we have introduced in mechanics.

4.9 ELECTRIC CURRENT AND SUPERCONDUCTIVITY (ND)

We have already discussed **electric current** in conjunction with its SI unit, "ampere" (4.2). Now we shall introduce some common applications of this quantity in electricity that are of practical importance. From the method of definition and measurement (95), current is an **action potential** of the electric level(s) and systems: $I = \Delta Q/\Delta t = \mathrm{SP(A)}[2d\text{-}space]\ f = E_A$. When its unit „ampere" is expressed in the new space-time symbolism, we acquire the following equivalence between *ampere* and the two basic units, *meter* and *second*:

$$1\ A = 1\ C/1s = 1\ \mathrm{m^2 s^{-1}} \quad (135)$$

This is a very useful equation, which helps us to compare the results of electricity with those of mechanics. The electric current usually flows in wires that can be described as cylinders in terms of geometry. This has led to the following common equation of the current:

$$I = nqA\mathrm{v_d} = \mathrm{SP(A)}[2d\text{-}space]\ f \quad (136),$$

where $n = \mathrm{SP(A)}/[3d\text{-}space]$ is the number of free charge-carrying particles per unit volume, $q = \mathrm{SP(A)}[2d\text{-}space]$ is the charge that each particle carries, $A = [2d\text{-}space]$ is the cross-sectional area of the wire, and $\mathrm{v_d}$ is the drift velocity of the particles.

Further quantities of electricity will be presented in a concise form. One of them is the **resistance** *R*, which is a quantity of time *f* of the electric systems: „The current in a wire segment is proportional to the potential difference across the segment."[35] This is the famous **Ohm's**

[35] PA Tipler, p. 720.

law as an application of UE:

$$I = \left(\frac{1}{R}\right)V \Leftrightarrow E_A = \frac{1}{f}LRC = \frac{E}{f} \qquad (137),$$

where the electric energy E is regarded statically as LRC: $E = LRC$, SP(A) = 1. However, this is a mathematical convention, as the potential difference $\Delta V = LRC$ presupposes a measurement that should be expressed as SP(A). In equation (137), SP(A) is defined as the certain event SP(A) = 1 and does not appear, just as the sign „Δ„ for difference is omitted in the expression of the potential difference V. This is a typical inconsistency of mathematical presentation, which is inherent in conventional physics. The reciprocal of the resistance $1/R$ is called a „constant of proportionality“. This is a synonym for time $1/R = f$. The **resistance** is defined as the ratio of the two basic quantities of the electric system, the electric potential as LRC and the electric current as E_A (PCA):

$$R = \frac{dV}{I} = \frac{E}{E_A} = \frac{\mathrm{SP(A)}[2d - space - time]}{\mathrm{SP(A)}[2d - space]f} = f \qquad (137a)$$

The SI unit of resistance is called “**ohm“** (Ω), which is a synonym for a **reciprocal second**:

$$1\ \Omega = 1\ V/1\ A = 1\ s^{-1} \qquad (138)$$

The interpretation of resistance reveals the basic cognitive problems that traditional physics has to combat. The resistance of a given material is said to depend on: (1) its length, (2) its cross-sectional area, (3) the type of material, and (4) its temperature. The last quantity is thermodynamic time $T = f_{thermo}$. As all levels contain themselves as an element, the time of the electric level $R = f_{el}$ should depend on the time of the underlying levels. This is an axiomatic conclusion from the new theory of the Law. The first two quantities are of geometric nature (objects of thought) and do not appertain to real space-time, while the third quantity „type of material“ can mean anything. In the light of the new axiomatics, it is a circumlocution of our fundamental axiom which states that there are infinite levels and systems with a specific constant space-time. Another basic quantity of electric space-time is the **resistivity**:

> „The resistance of a conducting wire is found to be proportional to the length of the wire and inversely proportional to its cross-sectional area: $R = \rho(L/A)$, where the proportional constant ρ is called the resistivity of the conducting material.“[36]

When we express this quantity in the new space-time symbolism:

$$\rho = R\frac{A}{L} = f\frac{[2d-space]}{[1d-space]} = [1d-space-time] \qquad (139),$$

we conclude that „resistivity“ is a **specific velocity** of the conducting material - it is a one-dimensional space-time quantity that is a specific constant of each electric system (material). The reciprocal of resistivity is called **conductivity** $\sigma = 1/[1d\text{-}space\text{-}time]$. This is the degree of mathematical freedom - we can either use the actual magnitudes or their reciprocals. This elaboration reveals that the electric quantities are pleonasms of the quantities introduced in classical mechanics. Gravitational and electromagnetic levels (fields) are U-sets and cannot be discriminated in real terms, but only within mathematics. They appertain to space-time. This leads to the unification of Newtonian mechanics with Maxwell's electromagnetism (see below).

The Theory of Superconductivity in the Light of the Universal Law

The new axiomatics allows the development of a consistent theory of **superconductivity** that will substitute the present BCS theory and ultimately lead to the development of adequate superconductors. This new theory of tremendous practical relevance for the future of mankind cannot be discussed in this appendix. We shall only present some basic derivations in the light of the Law.

According to **Lorentz' theory of conductivity**, the charged particles can be regarded as an assembly of kinetic particles (electron gas theory) that can be statistically described by the **root mean square velocity:**

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[36] PA Tipler, p. 721.

$$\mathsf{v}_{\mathrm{rms}} = \sqrt{\frac{3k_bT}{m_e}} = [1d - space - time]$$

The kinetic motion of the electrons is described in terms of their **collision time** τ by employing the classical paradigm of „elastic collision" as a closed system (N-set). This approach explains the limited character of this theory. The collision time is the reciprocal absolute time of the **kinetic electron level** $1/\tau = f_{el} = \mathsf{v}_{\mathrm{av}}/\lambda$, where the **mean free path** λ is the constant [1*d-space*]-quantity of this level. Departing from equation (136), the **resistivity** (139) can be expressed in terms of the mean free path λ and the mean speed of electrons $\mathsf{v}_{av}\, f_{el}$ as follows (1.9 & 4.2):

$$\rho = \frac{m_e \mathsf{v}_{av}}{ne^2\lambda} = \frac{m_p f_{c,e} f_{el}}{nq_p{}^2 f_{c,e}{}^2} = \frac{m_p f_{el}}{nq_p{}^2 f_{c,e}} = \frac{m_p f_{el}}{neq_p} = [1d - space]f = \mathsf{v}_{el},$$

$$\text{when } 1/\mathrm{SP(A)} = 1 \qquad (140),$$

where $\mathrm{SP(A)} = \mathrm{SP(A)_e} \times \mathrm{SP(A)_{qp}}$ (see above), and $f = f_{el}/f_{c,e}$ is the resultant time as a function (quotient) of the time of the kinetic electron level and the intrinsic time (Compton frequency) of the electron. Equation (140) reveals that all levels are open U-sets, so that their space-time can be assessed in relation to other levels. It also confirms that the electric resistivity depends on the mass m_p and charge q_p of the basic photon h and on the time f_{el} of the underlying electron level.

Superconductivity is defined by the conditions T_c and $R = 0$. Both are quantities of time. Under these boundary conditions, the electric current that has been initiated can flow in ring conductors for a very long time without any external potential maintaining the current. This means that the electric energy is practically inexhaustible, as the losses of electric energy will approach zero $E_{loss} = I/dt = E_A\, f \to 0$, when $dt = 1/f \to \infty$. In the state of superconductivity, the energy exchange with the other contiguous U-levels of matter is reduced to a minimum so that the electric level can be regarded as an almost closed level. This is the current cognitive approach of the BCS theory to superconductivity.

The problem of developing new superconductors that are not brittle and have a normal T_c can be tackled in a successful way when the energy exchange with the adjacent levels is considered. Only by employ-

ing the **broad** approach of the Universal Law can we solve the crucial problem of superconductivity, on which the future of mankind will most probably depend. This has been demonstrated by the novel equation of resistivity (140). It shows that the resistivity is proportional to the product of the mass of the basic photon (energy) and the specific time of the electric level $\rho \approx m_p f_{el}$, and inversely proportional to the collision time $\rho \approx m_p/\tau$. Thus the solution to the problem of superconductivity is to find a method of decreasing the specific time of the kinetic electron level f_{el} (increase in the collision time of the electrons) in order to reduce resistivity. One possible way of achieving this is to reduce the time of the thermodynamic level to the critical value of T_c, at which the amount of the exchanged energy between this level and the electric level as determined by $K_{av} = 3/2k_bT_c$ becomes minimal.

We should bear in mind that the frequency of the maximal energy exchange with the photon level depends on T: $f_{max} = K_{CBR}T$ (82). A decrease in T will minimise the energy exchange between the thermodynamic level of matter and that of photon space-time. This portion of energy is lost for practical use and determines the availability of energy to mankind. The thermodynamic energy emitted to the photon space-time as assessed by Stankov's law (3.7) is lost for practical purposes (see Carnot cycle). The other alternative is to modulate the crystal structure of the conducting material in accordance with the horizontal and vertical energy exchange between the levels of matter and between matter and photon space-time with the objective of reducing K_{av}. The solution of this mathematical problem through computer simulations is beyond the scope of this survey.

The epistemological shortcomings of the present BCS theory begin with the concept of **Fermi-energy**. The problem with the classical model of **free electron gas** lies in the assumption that the mean kinetic energy of electrons is $K_{av} = 3/2k_bT$. This equation is obtained within geometric formalism by making certain assumptions (see chapter 3.3) that have not been proven to be true for the electrons, which have a different structural complexity to that of the particles at the thermodynamic level. At present, the electron is regarded as a hemisphere with the surface of $m_B = 1/2\pi\lambda_{c,e}{}^2$, called Bohr magneton (see equation (100) & (102), or with the cross-sectional area of $e = 2\pi^2 f_{c,e}(\lambda_{c,e}/\lambda_A)^2$, called „charge" (104). These geometric quantities play an important role in the theory of superconductivity. This is, however, speculative geometry applied to the quantum level, to which we have no direct access.

According to the BCS theory, at the critical temperature of T_c the electrons become bound in pairs, called **Cooper-pairs** ($\tau = 1/f_{el} \rightarrow \infty$, $\rho \rightarrow 0$). In any Cooper-pair, the two electrons have an opposite **spin** so that the total spin of the pair is zero. What is the epistemological background of these descriptive statements? As already said, each system of space-time can be regarded as a rotation, which is the origin of waves or, alternatively, as a rotational wave (de Broglie's interpretation of Bohr's quantization model of the electron). The term „spin" is a synonym for the **own angular momentum** of the particle $L = mvr = mr^2\omega$ (24) that is expressed in terms of the moment of inertia $L = I = mr^2$ (22), when the angular velocity, also called angular frequency, is regarded as the certain event $\omega = \mathrm{SP(A)} = 1$. This means that the term „spin" is introduced with respect to one revolution of the internal rotation of the particle, which is expressed as a structural complexity, that is, as an area $L = E_{Aparticle} = I = K_s = \mathrm{SP(A)}[2d\text{-}space] = \mathrm{SP(A)} = 1$. This is a common method of magnetism and quantum mechanics. Hence the key role of wave theory in assessing the space-time of rotations. As the electron is geometrically regarded as a hemisphere, we have, in fact, only half of a revolution of this particle, so that the spin of the electron is given as 1/2 (fermion due to Pauli exclusion principle, asymmetrical function of Schrödinger wave equation, etc.). Formally, this is expressed as follows:

$$electron - spin = \frac{1}{2}\hbar = \frac{h}{4\pi} = \frac{m_p \lambda_A{}^2}{4\pi} =$$

$$= circle - area = \frac{circumference^2}{4\pi} \qquad (141)$$

The **electron spin** (1/2) is defined geometrically as the **area of a circle** with respect to the square circumference $\lambda_A{}^2$ and the mass m_p of the basic photon h. Their product is expressed as K_s within geometry, which is the method of definition of this quantity: electron spin $= K_s = m_p\lambda_A{}^2 = \mathrm{SP(A)}[2d\text{-}space]$. Equation (141) embodies the geometric (mathematical) origin of all terms and quantities in physics and, in particular, of those in quantum mechanics. This is the epistemological background with which the basic statements of the BCS theory can be interpreted in a novel way. This also holds for **Meissner-**

Ochsenfeld-effect and all other aspects of this theory. This prospect is exciting, as the new theory of the Law will ultimately solve the energetic problem of mankind and thus guarantee its survival as a transgalactic species.

The BCS theory cannot ignore the discrete character of space-time. For this purpose, it introduces a new quantity, called the **magnetic flux quantum**, which is regarded as the smallest constant energy quantum, that is, as the **basic action potential** of the magnetic level:

$$\phi_m = \frac{h}{2e} = \frac{m_p \lambda_A{}^2 f_p}{2q_p f_{c,e}} = \frac{m_p \lambda_A{}^2}{2q_p f_{c,e}} = \frac{1}{2} \times \frac{K_{s(mass)}}{K_{s(charge)}} \times \frac{[2d - space]_p}{f_{c,e}} = E_A,$$

$$\text{as } f_p = 1 \qquad (142),$$

where $f = f_p / f_{c,e}$ and $K_{s(mass)}/K_{s(charge)} = \mathrm{SP(A)}$. The magnetic flux quantum is a quantity of photon space-time. This proves the intrinsic link between superconductivity and the vertical energy exchange between matter and photon space-time. This aspect is not considered by the BCS theory. Hence its intrinsic inability to solve the problem of superconductivity.

4.10 THE MAGNETIC FIELD (ND)

The terms **electricity** and **magnetism** describe two levels of space-time as U-subsets that are interdependent and exchange energy. Magnetism results from electric currents (motion is the universal manifestation of energy exchange) within the level of matter. The motion of the electric currents are **rotations** that superimpose. For instance, the electron spin is a synonym for the intrinsic rotation of this particle. Since the electron rotates in addition at the molecular level, this particle, considered to be the carrier of electricity and magnetism in matter, can be regarded as a **superimposed rotation**. Such rotations can be described with UE for rotations. The term „magnetism“ describes an interaction between **moving** charges, while „electricity“ describes an interaction between **static** charges (Coulomb’s law). This is an abstract discrimination within the realm of mathematics. In reality, all systems and levels are in incessant motion. The paradigm „charge (area) in motion“ assesses this intrinsic

property of space-time. Therefore, we can conclude that the terms „electricity“ (static) and „magnetism“ (motion) merely embody the fundamental dualism of present physical outlook, and therefore should be regarded as an entity - hence the term „**electromagnetism**“.

The term „electromagnetism“ includes the vertical energy exchange between matter and photon-space time. This has been intuitively felt by introducing the concept of the „**magnetic field**“ analogously to the concept of the „electric field“. However, while the latter has the dimensionality of acceleration $\mathsf{E} = [1d\text{-}space\text{-}time]\ f$, the magnetic field is defined as a quantity of time $B = f$. Thus magnetism introduces the constituent time as a basic quantity of energy exchange.

The magnetic field is defined through the magnetic force. The method of definition and measurement of the **magnetic force** is geometry and algebra, and is based on the following experimental evidence: 1) The magnetic force, also called **Lorentz force,** is proportional to the charge (area) of the particles $F \approx q = K_s$; 2) The force is proportional to the speed $F = \mathrm{SP(A)}[1d\text{-}space\text{-}time]\ f \approx \mathsf{v} = [1d\text{-}space\text{-}time]$; 3) The force F is proportional to $sin\theta = 0 \leq \mathrm{SP(A)} \leq 1$, where θ is the angle between the velocity v and the magnetic field B expressed as vectors: $F \approx 0 \leq \mathrm{SP(A)} \leq 1$; 4) If v is parallel or antiparallel to B, the force is zero $F = \sin 0^{o} = \mathrm{SP(A)} = 0$ (improbable event); 5) If v is perpendicular to B, then the force is perpendicular to both vectors $F = sin90^{o} = \pi/2 = \mathrm{SP(A)} = 1$ (certain event).

As we see, the experimental evidence of magnetism, leading to the introduction of the magnetic force and the magnetic field, can be axiomatically obtained from the primary term within mathematical formalism (empiricism as a tautology of the Law). The basic method of definition and measurement of the magnetic quantities is the **sinus-cosines function**, which is another mathematical presentation of the continuum. This method reveals the well known fact that (electro)magnetism is of wave character. The above relationships can be summarized in a simple equation of the **magnetic force**, from which the dimensionality of the **magnetic field** can be easily determined:

$$F = q\mathsf{v} \times B \ \text{ or } \ B = \frac{F}{q\mathsf{v}} = \frac{\mathrm{SP(A)}[1d - space - time]f}{\mathrm{SP(A)}[1d - space - time]} = f \qquad (143)$$

The magnetic field is a particular quantity of space-time. This equation is usually presented in 3d-Euclidean space by employing manual power - by the so-called „right-hand rule". The SI unit of magnetic field is „**tesla"** [T], which is a synonym for the reciprocal of the basic SI unit of conventional time, 1 *second*:

$$\mathbf{1\ tesla = 1\ s^{-1}} \tag{143a}$$

This equivalence has not been comprehended so far and has led to some awkward interpretations that may transpire to be of great embarrassment to physicists. For instance, the magnetic field of the earth is calculated to be in the magnitude of 10^{-4} tesla, which is equivalent to 10^4 seconds:

$$B_{earth} = 10^{-4}\ \text{tesla} = 10^4\ \text{s} \tag{144}$$

For this reason B_{earth} is considered to be very weak. In fact, the magnetic field tells us how often an action potential is repeated when the universal equation is applied $E = E_A\, f = E_A B_{earth}$. As the earth is a rotating system, we can set for its action potential the angular momentum of the earth $L_{earth} = E_A$ (24) expressed as an area (moment of inertia) $K_s = I_{earth} = \text{SP(A)}R^2$ (R = earth's radius) for one rotation around its axis $\omega = f = B_{earth} = 1$ (22). If we now express the time of one rotation of the earth $f = B_{earth} = 1$ with the SI unit 1 *second*, we obtain the time of the earth's rotation as a pure number $f = \text{B}_{\text{earth}} = = 1/t = 1\ \text{day}/1\ \text{s} = 8.64{\times}10^4\ \text{s}/1\ \text{s} = 8.64{\times}10^4$. In conventional terms, the time the earth takes for one rotation $f = 1$ is equivalent to $8.64{\times}10^4$ seconds: $f = 1$ (rev) $= 8.64{\times}10^4$ [seconds], e.g. 1 billion $ is equivalent to 1 000 000 $. This time is almost equivalent to the experimentally measured magnetic field of the earth in tesla:

$$B_{earth} = 10^{-4}\ \text{tesla} \cong 8.64 \times 10^4\ \text{[seconds]} \tag{144a}$$

Instead of measuring the magnetic field of the earth, scientists have practically measured the number of seconds in one day, which is equivalent to one revolution of the earth around its axis. How can we explain the small difference? The duration of the day, respectively, of the SI unit 1 second, is defined in terms of the solitary revolution of the earth around its axis and neglects the superimposed rotation of the earth around the sun, the rotation of the solar system around the centre of the galaxy, the

rotation of the Milky Way around the local group, and so on. The magnetic field gives the **aggregated time** of this superimposed rotation of the earth. Therefore, the aggregated rotational time (in tesla) is slightly different from the time of the earth's rotation around its axis when the latter is regarded as a solitary motion (one day in seconds). The resultant axis of the superimposed rotation is also different from the earth's own axis. Hence the different location of the earth's magnetic pole with respect to the North pole. This example illustrates both the empirical power of the new axiomatics - its ability to explain any phenomenon in a consistent way - and the cognitive blindness of traditional physics even on such simple issues of tremendous practical importance as the earth's magnetism, for instance in navigation.

Equation (143) is the departing point of several derivations of UE within magnetism, which assess actual (electro)magnetic systems from the geometric point of view. We shall present one such application: the **torque** (21) of current loops and magnets:

$$\tau = m \times B = mB = (NIAn)B = \mathrm{SP(A)}[2d\text{-}space\text{-}time] \qquad (145),$$

where m is called the **magnetic moment** of the current loop (not to be confused with mass), N is the number of turns, A is the area of the loop, I is the current in the loop, and n is a unit vector. The product $NIAn$ is the magnetic moment (see 4.12). From equation (145), it becomes evident that this quantity is defined as an action potential $m = \tau/B = \mathrm{SP(A)}[2d\text{-}space]\ f$. One can obtain the same dimensionality for the magnetic moment when one departs from the product $m = NIAn$ and considers its definition within geometry. The above equation confirms that all electromagnetic systems can only be assessed as rotations - for instance, torque is a synonym for rotating space-time (21).

Like the electric field, the magnetic field is also depicted by **magnetic-field lines**. This geometric presentation is a pure abstraction and has no correlate in the real world. The link between the two fields is obtained by the velocity of the electric system (charge), which is one-dimensional space-time of the particle:

$$\mathsf{v} = \frac{\mathsf{E}}{B} = \frac{[1d - space - time]f}{f} = [1d - space - time] \qquad (146)$$

This is another iteration of the Law for one-dimensional space-time. The development of the concept of magnetism has produced a useful relationship between the charge of the electron and its mass (Thompson's measurement), which is an application of UE as an RT:

$$\frac{q}{m_e} = \frac{\mathrm{SP(A)}[2d-space]_{charge}}{\mathrm{SP(A)}[2d-space]_{mass}} = \frac{\mathrm{SP(A)}_{area}}{\mathrm{SP(A)}_{energy-relation}} = \mathrm{SP(A)} \quad (147)$$

This quotient has played a central role in the development of the theory of relativity, first in electromagnetism (Lorentz) and then in the special theory of relativity (Einstein). Equation (147) is the method of definition and measurement of the **mass spectrometer** (priority of theory over empiricism), which is a basic instrument of modern chemistry. It is used to find the **mass-to-charge ratio** of ions of a known charge (area) by measuring the radius of their circular orbits in a uniform magnetic field $r = m\mathrm{v}/qB$. When this formula is solved for the charge-mass quotient in (147), we realize why experimental research is a tautology of the Law - it always assesses the continuum or the probability set, that is, the primary event:

$$\frac{m}{q} = \frac{B^2 r^2}{2\Delta V} = \frac{f^2[2d-space]}{2[2d-space-time]} = \mathrm{SP(A)} \quad (147a)$$

This example illuminates how the mathematical method of definition of quantities is introduced as a method of measurement in research - a fundamental theoretical aspect of science that has remained cryptic to physicists until the discovery of the Law. It focuses on the central conclusion of the new axiomatics, namely, that any experimental result is part of the continuum (the set of all numbers), so that this abstract term of mathematics is equivalent to the primary term.

The tautological character of any experimental research can be illustrated by another expensive toy of physicists, financed by the aggregated product of the taxpayers - the **cyclotron**. The **kinetic energy of cyclotrons** is an application of UE:

$$E_{kin} = \frac{1}{2}\left(\frac{q^2B^2}{m}\right)r^2 = \mathrm{SP(A)}[2d-space-time] \quad (148)$$

4.11 THE QUANTUM HALL EFFECT (ND)

The magnetic force which an electromagnetic photon system exerts on a current-carrying wire (material electric system) acts on the microscopic carriers of the electric current - the electrons. This results in a separation of charges (electrons and ions), called the **Hall effect**. This phenomenon describes the vertical energy exchange between a photon system and an electric material system. Such an interaction can be precisely interpreted in terms of the reciprocal behaviour of the *LRCs* of two contiguous levels, which is a basic axiom of the new axiomatics.

The separation of the charges leads to the building of the **Hall voltage** V_H, that is opposite to the magnetic force $F = q\ \mathsf{v}_\mathrm{d} \times B = q\mathsf{E}$ (143), where v_d is the drift velocity of the charge carriers and $\mathsf{E} = \mathsf{v}_\mathrm{d} \times B = [1d\text{-}space\text{-}time]\ f$ is the electric field or acceleration of the photon system (107). When we consider the width w of the wire strip, we can express the space-time of the photon system in terms of its **electromagnetic potential** V_m or LRC_m:

$$V_m = LRC_m = w\mathsf{E} = w\mathsf{v}_\mathrm{d} \times B = [2d\text{-}space\text{-}time]_m \qquad (149)$$

This *LRC* is equivalent to the **Hall voltage** in magnitude, but opposite in direction:

$$V_H = LRC_H = w\mathsf{E} = w\mathsf{v}_\mathrm{d} \times B = [2d\text{-}space\text{-}time]_m \qquad (149a)$$

The Hall voltage is the *LRC* of the material electric level, which is reciprocal to the electromagnetic potential of the contiguous photon level. This is an aspect of the reciprocity of space and time. It terms of mathematics, this physical relationship can be expressed by using the minus sign $V_H = -V_m = -w\mathsf{E}$, or the number „1“ for reciprocity. Both methods of expression are equivalent abstract conventions of mathematics in terms of human cognition. In the present case, we regard the electromagnetic photon level and the electric material level as two U-subsets of space-time that contain themselves as an element. They build a new system, the space-time of which can be assessed according to AR and expressed in terms of statistics as the certain event (method of definition and measurement):

$$V_H V_m = \mathrm{SP(A)} = 1 = \text{certain event, or } V_H = 1/V_m \qquad (150)$$

Equation (150) gives the reciprocal character of the two *LRCs* of the resultant system as a quotient. We should be aware of the fact that we can assign any other number to the resultant system SP(A) = 1/*n* without affecting the real content of this formula.

This reciprocity can be presented in many different ways, depending on the quantities used. For instance, instead of the Hall voltage we can consider the electric current $I = nq\mathsf{v}_d\, A = nq\mathsf{v}_d wt$, where n = SP(A)/[3*d*-*space*] = ρ (47) is the number of moving charges (areas) per unit volume in the wire strip with the cross-sectional area of $A = wt$ (t is thickness of the wire strip). The geometric approach is cogent. When the formula of the current is rearranged by substituting $\mathsf{v}_d w = V_H/B$ from equation (149a), we obtain for the **number** of **moving electron charges** or **areas (**$q = e$) the following practical equation:

$$n = \frac{IB}{etV_H} = \frac{\mathrm{SP(A)}[2d - space - time]}{\mathrm{SP(A)}[2d - space]\times[1d - space]\times[2d - space - time]} =$$

$$= \frac{\mathrm{SP(A)}}{[3d - space]} \qquad (151),$$

where SP(A) = SP(A)/SP(A). Equation (151) is a mathematical iteration of the formulae of the Hall voltage (149a) and the electromagnetic potential (149) and gives the density (47).

The Hall effect assesses the energy interaction between any electromagnetic photon system and any material electric system at the macroscopic level - the Hall voltage is the macroscopic aggregated product of the electric microscopic interactions at the particle level. These interactions are assessed by the **quantum Hall effect,** as first described by Klaus von Klitzing, for which he received the Nobel prize in 1985. When the $LRC_H = V_H$ of the material electric system is given as a function of the time of the electromagnetic photon system, the magnetic field $f_m = B$, the plot of V_H results in a series of plateaux indicating that the Hall voltage is **quantized**. Energy (space-time) is always quantized - it manifests itself in constant action potentials. Thus the quantum Hall effect is a tautological experimental confirmation of our axiomatic conclusion concerning the inhomogeneous character of space-time, just as all achievements in science awarded with the Nobel prize are intuitive tautological

confirmations of the Law within the realm of mathematics. It is, indeed, an irony that Nobel deliberately excluded mathematics from his award.

The quantization of Hall voltage is expressed by the so-called **von Klitzing constant**, which is given as a ratio of the basic photon and the electric charge (PCA) and has the dimensionality of the resistance (137a):

$$R_K = \frac{h}{e^2} = \frac{m_p}{q_p^{\,2}}\lambda_{c,e}^{\,2} = \frac{\mathrm{SP(A)}\left[2d-space\right]_{m_p}\left[2d-space\right]_{electron}}{\mathrm{SP(A)}^2\left[4d-space\right]_{q_p}} =$$

$$= \frac{1}{\mathrm{SP(A)}} = \mathrm{SP(A)} = f = 25813\,[\mathrm{s}^{-1} = \Omega] \qquad (152)$$

Equation (152) is an application of UE as an RT. This constant is used as a method of definition and measurement of the SI unit, "ohm". In fact, von Klitzing constant is a hidden definition and an adequate method of measurement of the basic SI unit second. This becomes evident when we express this constant in terms of time:

$$R_K = \frac{h}{e^2} = \frac{m_p\lambda_A^{\,2}}{q_p^{\,2}} \times \frac{f_p}{f_{c,e}} = \mathrm{SP(A)}\frac{f_p}{f_{c,e}} = \mathrm{SP(A)}\, f = f \qquad (152a)$$

Formula (152a) is also UE as an RT. Here, the time of the basic photon f_p has been chosen as the reference periodicity, to which the intrinsic time (periodicity) of the electron, the Compton frequency, is set in relation (PCA). Such formulae do not enlarge our cognitive knowledge, but merely illustrate the infinite potential of mathematics in creating new physical quantities and relationships - space-time is an infinite continuum.

4.12 PRECURSORS OF MAXWELL'S EQUATIONS-ELECTROMAGNETISM OF MATTER

The precursors of Maxwell's equations are: 1) **Biot-Savart law** 2) **Ampère's law** 3) **Stokes' integral theorem** of **Ampère's law** 4) **Gauss's law of magnetism** 5) **Faraday's law**. These laws are appli-

cations of UE - they are obtained by introducing new quantities of electromagnetism and by building various relationships between them. For this reason they can be unified in the four Maxwell's equations of electromagnetism.

Biot-Savart law was deduced by Ampère from Coulomb's law for the electric field of a static point charge q = SP(A)[2*d-space*] by replacing it with the current element Idl = [2*d-space-time*] (4.2, definition of Ampère). When we replace the product qv with the current segment Idl in the equation of the magnetic field $B = F/q$v (143): qv = SP(A)[1*d-space-time*] = $p_{el} = Idl$ = [2*d-space-time*] = LRC_{el} = [*n-d-space-time*] (PLE), and express the force by Coulomb's law, we obtain **Biot-Savart-law** for the magnetic field:

$$dB = \frac{\mu_0}{4\pi}\frac{Idl \times \mathsf{r}}{r^2} = f \qquad (153),$$

where r is a unit vector. The method of definition of this law is geometry. Biot-Savart law can be applied to a current loop described as a circle, solenoid, or straight wire. The actual geometry of the macroscopic electric systems can vary infinitely.

In 4.5 we have shown that Gauss's law is a derivation of Coulomb's law by introducing the quantity electric flux. Analogously, **Ampère's law** has been derived for the magnetic field by assessing the tangential component of B summed around a closed curve C (usually the circumference of a circle) to the current I_c, which passes through the curve (area of the circle):

$$\oint_C B \cdot dl = \mu_0 I_C = \mathrm{SP(A)}[1d - space - time] = p \qquad (154)$$

Ampère's law is an application of the axiom of CAP by using the quantity momentum. This law assesses the vertical energy exchange between the magnetic photon system $\oint_C B/\mu_0 = Bl_{\mu_0} = \mathrm{SP(A)}[1d - space - time]_m$ (see (110), SP(A) stands for integration) and the material electric current-system I_C/dl = SP(A)[1*d-space-time*] in terms of energy conservation. Ampère's law iterates the law of conservation of momentum of classical mechanics for electromagnetism. In equation (154), the tangential component of the magnetic field corresponds to the angular frequency

(154a). This shows that electromagnetism is a synonym for the vertical energy exchange between the magnetic photon level and the electric level of matter. This law is used to describe a collection of electric systems of varying geometry. The most common one is the **toroid**:

$$\oint B \cdot dl = 2\pi rB = 2\pi rf = \omega = \text{angular velocity} \qquad (154a)$$

This formula is an application of UE for the space-time of rotations (1.4, (17)). It confirms that the magnetic field in Ampère's law is angular frequency. The application of Ampère's law has been found to be limited. Maxwell solved this problem by introducing a new quantity - the **displacement current** (4.13).

Within mathematics, one can express the magnetic field by gradient building (4.6). Demonstrating the infinite propensity of mathematical consciousness to create new symbols, Stokes introduced a novel symbol called „rotation" instead of the Nabla operator: $\nabla B = rot\ B = f/[1d\text{-}space] = Bn$, where n is defined as a vector $n = \mathsf{n}/[1d\text{-}space]$ ($\mathsf{n} = 1$ is a unit vector) that is perpendicular to the area A of any electric system, for instance of a loop. The term „rotation" illustrates that Stokes must have intuitively felt that B is defined as an angular frequency, and that his **integral theorem** of **Ampère's law** describes a simple rotation. This new presentation of Ampère's law is set equivalent to the **magnetic flux** ϕ_m in an analogy with Gauss's law (119):

$$\phi_m = \oint_C B \cdot dl = \int_S B \cdot \mathrm{n} dA = \mathrm{SP(A)}[1d - space - time] = p \qquad (155)$$

Stokes' integral theorem is an iteration of known mathematical patterns - of Gauss's law of electric flux (119) and of Ampère's law (154) - that is continued in Faraday's law and Gauss's law of magnetism. Strictly speaking, the magnetic flux in (155) has the dimensionality of a momentum. However, when the vector n is regarded as a pure number $n = \mathsf{n}/[1d\text{-}space] = [1d\text{-}space]_{\mathrm{normal}}/[1d\text{-}space] = \mathrm{SP(A)}$, the magnetic flux acquires the dimensionality of an action potential (see Gauss's law of magnetism below):

$$\phi_m = E_A = \mathrm{SP(A)}[2d\text{-}space]\ f \qquad (155a)$$

The three laws have been designed to describe the vertical energy exchange from the electric level of matter to the magnetic photon level. In the early 1830s, M. Faraday and J. Henry discovered independently that a magnetic field can also induce an electric current in a wire, but only when it is changing. This confirms our axiomatic conclusion that any energy exchange occurs in both directions. Changing magnetic fields produce **induced emfs** (electromotive forces), also called **induced potentials** (induced *LRC*), and i**nduced currents**. The vertical energy exchange from the magnetic photon level to the electric level of matter is referred to as **magnetic induction**. This approach has led to the derivation of **Gauss's law** of **magnetism** from Stokes' integral theorem (155-155a):

$$\phi_m = BA = \mathrm{SP(A)}[2d\text{-}space]\, f = E_A \qquad (156)$$

In this law, magnetic flux is defined as the action potential of the magnetic photon system that is transformed into the action potential of the electric system of matter, conventionally called „induced current". In the conventional theory of electromagnetism, this vertical energy exchange is assessed by **Faraday's law,** which is an application of CAP as expressed for the *LRC*:

$$\varepsilon = U = LRC = \int_C \mathsf{E} \cdot dl = -\frac{d\phi_m}{dt} = LRC_{el} = -LRC_m \qquad (157)$$

Equation (157) assesses the reciprocal behaviour of the *LRC* of contiguous levels. The integral calculus used for the electric long-range correlation $LRC_{el} = \int_C \mathsf{E} \cdot dl$, and the differential calculus used for the magnetic $LRC_m = d\phi_m/dt$ implicate a measurement, so that equation (157) actually defines the space-time of the two levels - the magnetic photon level and the electric level of matter. Thus Faraday's law simply says that energy (space-time) is conserved, while being exchanged. Indeed, physics can be an open book when appropriately interpreted.

The precursors of Maxwell's equations shed light on the **magnetism of matter**. Until now we have been speaking of magnetism as a property of photon space-time - of the magnetic field *B* as the time and of the magnetic flux ϕ_m as the action potential of the magnetic photon level. In reality, all systems and levels of space-time are U-sets that contain them-

selves as an element. It is not possible to distinguish the magnetism of photon space-time from that of matter. The concept of "magnetism in matter" is a convenient way of describing some material microscopic levels in terms of electromagnetism. In this sense, one speaks of **magnetisation** ***M*** of materials, which is defined as the net magnetic dipole moment per unit volume of the material $M = dm/dV$.

Before we interpret this term, we must explain the basic quantity of magnetism - the **magnetic moment**. This quantity is usually defined for the microscopic level. It is an application of rotational mechanics to the atoms or particles of matter, which are regarded as rotating systems. The **magnetic moment** of the atoms is defined as the product of the current and the area of the circle:

$$m = IA = I\pi\, r^2 \tag{158}$$

There is no consistent epistemological explanation for this decision in the theory of magnetism. We shall now give one in the light of the new axiomatics. According to the method of definition and measurement of the electric current and its SI unit *ampere*, the magnetic moment is an arbitrarily selected constant amount of electric energy, to which the electric energy of other electric systems are compared $E/E_A = E/I = = E/1$ [*ampere*] $= f =$ SP(A). Within mathematics, we are allowed to express the symbol of the electric current with SP(A) = *n*. When we set this symbol in equation (158), we obtain for the **magnetic moment** the dimensionality of K_s:

$$m = IA = \text{SP(A)}[2d\text{-}space] = K_s = \text{moment of inertia} \tag{159}$$

As we are dealing with rotations, the magnetic moment expressed as K_s is equivalent to the quantity, moment of inertia *I* (22), which should not be confused with current (ambiguity of symbolism). This is a classical example of the dualistic approach in physics. Thus the actual definition of the magnetic moment which is vested behind the conventional derivation of this quantity is that of structural complexity called the „moment of inertia" of rotations. This can be illustrated when we scrutinize the conventional method by which this quantity is derived $I = qf = q/T = = \text{SP(A)}[2d\text{-}space]$, where the period is $T = 2\pi r/\mathsf{v}$, so that $I = q\mathsf{v}/2\pi r$. When *I* is substituted in equation (158) $m = IA$ and the latter is rearranged, we obtain for the **magnetic moment** the above result (159):

$$m = \frac{q}{2m_q} L = \frac{\mathrm{SP(A)}[2d - space]}{2\mathrm{SP(A)}[2d - space]} E_A = \frac{1}{2} E_A =$$

$$= \mathrm{SP(A)}[2d - space] f =$$

$$= \mathrm{SP(A)}[2d - space] = K_s, \text{ when } f = 1 \quad (160)$$

Equation (160) illustrates that the magnetic moment can be expressed in a dualistic manner: dynamically, as action potential with respect to angular momentum and statically, as moment of inertia with respect to the area of the circle. Thus the method of definition of the magnetic moment is simple geometry as with most other quantities in physics. In terms of knowledge, this method is fairly simple: the charged particle, for instance an atom, is regarded as a mass point m_q without space (volume) that rotates in empty space around an orbit with the radius r. The inadequacy of this formalistic view (N-set) is a recurrent motif of the present elaboration.

When we use equation (160) for the electron as the basic action potential of the electron level and set this quantity in relation to the basic photon (action potential) of the photon level, we obtain for the **magnetic moment** of the **electron** the following solution:

$$m = \frac{e\hbar}{2m_e} \frac{L}{\hbar} = \frac{q_p \lambda_A^{\,2}}{4\pi} \frac{L}{\hbar} = m_B \frac{L}{\hbar} = \frac{circumference^2}{4\pi} \times \frac{L}{\hbar} =$$

$$= circle - area \times \frac{L}{\hbar} \quad (161)$$

When the definition of the magnetic moment is applied to the electron, we obtain the basic natural constant, called **Bohr magneton** (100) within geometry:

$$m = K_s \frac{E_{A(L)}}{E_{A(\hbar)}} = \mathrm{SP(A)}[2d - space]\mathrm{SP(A)} = \mathrm{SP(A)}[2d - space] = K_s$$

or

$$m = m_B \quad (162)$$

Knowing the dimensionality of the magnetic moment, we can answer our initial question concerning the meaning of the term „**magnetisation**“:

$$M = \frac{dm}{dV} = \frac{\mathrm{SP(A)}[2d-space]}{[3d-space]} = \frac{\mathrm{SP(A)}}{[1d-space]} = \rho_m =$$

$$= \text{magnetic density} \tag{163}$$

This is the whole theoretical background of the magnetism of matter.

4.13 MAXWELL'S EQUATIONS ARE DERIVATIONS OF THE UNIVERSAL LAW

In 1860, J.C. Maxwell discovered that the laws of electricity and magnetism could be synthesized in a general mathematical presentation consisting of four interrelated equations. These equations contain the two Gauss's laws for electric (119) and magnetic flux (156), Biot-Savart law (153), Ampère's law (154), Stokes' integral theorem of Ampère's law (155), and Faraday's law (157). These laws are mathematical derivations of the Law for particular quantities of electromagnetism and their relations. The actual achievement of Maxwell was the introduction of a new quantity called **Maxwell's displacement current** (164), with which he eliminated the limitations of Ampère's law.

Maxwell's equations relate the electric field (acceleration) E and the magnetic field (time) B of the electromagnetic systems of photon space-time to their corresponding electric systems of matter, which are described in terms of charge $Q = K_s$ = area, current $I = E_A$ = action potential, and space quantities, [1*d-space*]- and [2*d-space*]-quantities. The epistemological achievement of Maxwell's equations is to furnish the evidence that the level of electromagnetism is of **wave character** - his equations can be combined to yield a **wave function** (170,a) that is identical to the classical wave function in wave theory and to Schrödinger wave equation of quantum mechanics.

Since de Broglie (1924), the wave character of matter is a well established fact in physics. In the new axiomatics, space-time is energy exchange. Its unique, universal manifestation is motion. Due to the closed

character of space-time, **all motions are superimposed rotations** - they are open systems of space-time and contain its properties as an element (U-subsets). Any rotation is a source of waves and vice versa - any wave can be regarded as a superimposed rotation. All systems and levels of space-time are particular superimposed rotations - their constant space-time can be assessed with UE. Waves (rotations) have the intrinsic capacity to create structural complexity with an infinite variety of forms, for instance as standing waves or solitons. Such forms have a finite lifetime that depends on the conditions of constructive and destructive interference. This is the basic epistemological outlook of the new axiomatics in terms of wave theory. It effects a great simplification in our physical view of the world and, in particular, of electromagnetism and quantum mechanics.

When Maxwell developed his four equations of electromagnetism through pure mathematical deduction, it was not known that electromagnetism was of wave character. Only 27 years later did H. Hertz confirm it experimentally. This historical glimpse illustrates the priority of deductive knowledge over empiricism and rejects empiricism as an epistemological approach. Hertz' result was anticipated by another basic equation of electromagnetism, which was deduced by Maxwell from the primary term of our consciousness in an intuitive manner - that of the **speed of light** (105):

$$c^2 = \frac{1}{\mu_0 \varepsilon_0} = LRC = \mathsf{E}_0 l_{\mu_0} = [1d - space] f [space] = [2d - space - time]_p$$

This equation reveals that the square speed of light, respectively, the *LRC* (universal potential U_U) of photon space-time, can be expressed as a product of its electric field or acceleration E_0 (109) and the magnetic field length $l_{\mu 0}$ (110):

$$c^2 = \mathsf{E}_0 l_{\mu_0} = 0.11294 \times 10^{12} [\mathrm{ms}^{-2}] \times 0.795775 \times 10^6 [\mathrm{m}] =$$

$$= 8.9875 \times 10^{16} [\mathrm{m}^2\mathrm{s}^{-2}],$$

or

$$c = 2.99792458 \times 10^8 \ [\mathrm{ms}^{-1}]$$

The two abstract quantities, E_0 and $l_{\mu 0}$, of photon space-time appear as natural constants in Coulomb's law (E_0), Gauss's law (E_0), Biot-Savart law ($l_{\mu 0}$), and Ampère's law ($l_{\mu 0}$). As these mathematical laws can be experimentally verified, the two constants of photon space-time can be easily determined in electromagnetic experiments (empiricism as a tautology of mathematics). Maxwell deduced their values theoretically from the speed of light, the magnitude of which had been known in astronomy for a long time.

The reason why Maxwell had to introduce the displacement current was the limitation of Ampère's law. This law measures the tangential integral of the magnetic field (angular frequency) around some closed curve *C* of an electric system to the current that passes through any area bounded by that curve:

$$\oint_C B \cdot dl = \mu_0 I_C = \mathrm{SP(A)}[1d - space - time] = p$$

This geometric approach is based on the notion of closed systems and holds only for non-interrupted currents, that is, for homogeneous electric systems of matter (conservation of momentum). In reality, space-time is inhomogeneous (discrete) and open. When we apply this axiomatic knowledge of the nature of space-time to Ampère's law, we must conclude that its basic statement „the current that passes through any (photon) system bounded by that curve" is a geometric abstraction which neglects the adjacent system that creates the magnetic system or field. For instance, if we have a capacitor that builds a magnetic field, according to Ampère's law there should be no current through the surface of the capacitor's plate because the electric charge (area) stops on the plate. This stems from the idea that electromagnetic waves are propagated in vacuum. In addition, Ampère's law does not consider the recharging of the capacitor.

In the new axiomatics, we define space-time as continuous, but discrete - the open systems and levels are contiguous and exchange energy. Above all, they are U-sets that contain themselves as an element - the space-time of any system is the aggregated product of infinite other levels that can be integrated into two levels. The space-time of the system can be regarded as an interaction between these two levels (AR). This is precisely the axiomatic conclusion which Maxwell intuitively recognized. He realized that Ampère's law can be presented in a generalized form so as to include all practical situations, if the current *I* in the above equation

is replaced by the sum (aggregated product) of the **conduction current** I and another component I_d, since then called **Maxwell's displacement current**:

$$I_d = \varepsilon_0 \frac{d\phi_e}{dt} = \frac{d\phi_e}{\mathsf{E}_0 dt} = \frac{Esf}{\mathsf{E}_0} = \mathrm{SP(A)}[2d - space]f = E_A \qquad (164)$$

This definition incorporates Gauss's law of electric flux $\phi_e = \mathsf{E}_0 A$ with the dimensionality of $\phi_e = Es = E_A \mathsf{v}$ (119, a,b). The electric field E_0 is a quantity of the magnetic photon system.

> Thus the **displacement current** is a definition of the **action potential** of the magnetic system that is built around any electric system (current I) of matter.

This action potential is regarded from a dynamic point of view and is set in relation to the action potential of the electric system of matter - to the current I. This is the actual advantage of Maxwell's approach over that of classical electricity and magnetism. It is an intuitive application of AR: the space-time of the resultant electromagnetic system (U-set) is the product of the two interacting action potentials. When the axiom of CAP is applied, the resultant action potential of the system can be presented as the sum of the two action potentials within mathematics (degree of mathematical freedom) $I_{sum} = I + I_d$. Maxwell sets this new quantity in **Ampère's law** and solves it for the **momentum**:

$$\oint_C B.dl = \mu_0 (I + I_v) = \mu_0 I + \mu_0 \varepsilon_0 \frac{d\phi_e}{dt} = \frac{I_{sum}}{l_{\mu_0}} =$$

$$= \mathrm{SP(A)}[1d - space - time] = p \qquad (165)$$

The final result of this law remains the same. The new presentation of Ampère's law has the advantage that it involves the two interacting action potentials. If we now consider that all systems are open U-sets that interact, we must include all action potentials to obtain the exact equation of space-time. This circumstance is known in electromagnetism as the **principle of superposition**. It explains why Maxwell's equations

result in complex mathematical calculations when applied to the real world. Mathematics is the only adequate perception of space-time, but only within the limits of the approximation which it introduces through its symbols - the closed real numbers.

As with all other laws, Maxwell's new derivation of Ampère's law is also based on the paradigm of „area in motion". This can be easily demonstrated. The sum of the two currents corresponds to the net current that flows in the space of the electromagnetic (photon and electric) system. This results in an increase of the area (charge) within the volume of this system $I_{sum} = dQ/dt$. This is the classical definition of electric current (4.9). This „area (charge) in motion" can be set in relation to the electric flux: $\phi_e = Q/\varepsilon_0 = \mathsf{E}Q$ (119b). When this equation is divided by *dt*, we obtain again the **displacement current**:

$$\varepsilon_0 \frac{d\phi_e}{dt} = \frac{d\phi_e}{\mathsf{E}dt} = \frac{dQ}{dt} = I_d = E_A \tag{166}$$

Evidently, the above formulae are mathematical iterations of UE: $E = E_A$, when $f = 1$. When the time *f* is considered, **Faraday's law** can be presented in a new mode with respect to Maxwell's displacement current:

$$\boldsymbol{\varepsilon} = \oint_C \mathsf{E} dl = -\frac{d\phi_m}{dt} = \mathrm{SP(A)}\left[2d - space - time\right] = E_A f \tag{167}$$

The symbol SP(A) stands for integration. The minus sign assesses intuitively the reciprocal behaviour of the *LRC* of contiguous levels.
The above derivations illuminate how the precursors of Maxwell's equations have been unified into the **general equation of electromagnetism**, which is a derivation of UE. Within mathematics, it is traditionally presented by the following **four Maxwell's equations:**

$$\oint_S \mathsf{E}_n dA = \frac{1}{\varepsilon_0} Q_{innen} = \mathsf{E}_0 Q_{innen} = Es = E_A \mathsf{v} \tag{168a}$$

$$\oint_S B_n dA = \mathrm{SP(A)}\, f\left[2d - space\right] = E_A = 0 \tag{168b}$$

$$\oint_C \mathsf{E} dl = -\frac{d}{dt}\int_S B_n dA = E_A \neq 0 \qquad (168c)$$

$$\oint_C B dl = \mu_0 I + \mu_0 \varepsilon_0 \frac{d}{dt}\int_S \mathsf{E}_n dA = p = \mathrm{SP(A)}[1d - space - time] \qquad (168d)$$

The above equations represent the **integral form** of the Law. Equation (168a) stands for Gauss's law of electric flux and expresses $E = E_A f$ in the mathematical form $Es = E_A \mathsf{v}$. Equation (169b) stands for Gauss's law of magnetism and Stokes' integral theorem of Ampère's law and tells us that any action potential can be unilaterally regarded as the „improbable event" $E_A = \mathrm{SP(A)} = 0$ when it is completely transformed into another action potential (CAP). Equation (168c) stands for Faraday's law and expresses CAP bilaterally $E_{A1} = (-)E_{A2} = \mathrm{SP(A)} \geq 0$. And finally, equation (168d) assesses the electromagnetic system resulting from the vertical energy interaction between the electric system of matter and the magnetic system of photon space-time as a momentum, which is presented as a vector (line) - hence the concept of electric and magnetic field-lines. We conclude:

> The **four Maxwell's equations** are mathematical derivations of the Law derived by AR - they assess the vertical energy exchange between the photon level presented as a changing *electromagnetic field* (E and B) and the electric level of matter (predominantly the electron level) given as a *current I* (E_A).

The above four integral equations can also be expressed in the **differential form** without affecting the final results. This is done by using Nabla operator $\nabla\ a = da_{x,y,z}\ /dx,y,z = a/[1d\text{-}space]$:

$$\nabla \mathsf{E} = 0 = \mathrm{SP(A)} \frac{[1d - space - time] f}{[1d - space]} = \mathrm{SP(A)}\, f^2 = f^2 = 0 \qquad (169a)$$

$$\nabla B = 0 = \mathrm{SP(A)} \frac{f}{[1d - space]} = 0, \text{ as } f \to 0 \qquad (169b)$$

$$\nabla \mathsf{E} = -\frac{dB}{dt} = \mathrm{SP(A)}\, f^{\,2} = f^{\,2} = \mathrm{SP(A)} = 1 \qquad (169c)$$

$$\nabla B = +\mu_0 \varepsilon_0 \frac{d\mathsf{E}}{dt} = \mathrm{SP(A)} \frac{f}{[1d - space]} = \mathrm{SP(A)} = 1,$$

$$\text{when } f = \mathrm{SP(A)} = 1 \text{ and } [1d\text{-}space\,] = \mathrm{SP(A)} = 1 \qquad (169d)$$

The above equations are said to hold in vacuum (empty space). In fact, they hold in photon space-time. They are mathematical iterations of Kolmogoroff's probability set, which is an equivalent concept of the primary term. We conclude:

> The **four Maxwell's equations** express in their **differential form** the **probability set** $0 \leq \mathrm{SP(A)} \leq 1$, which is a formalistic mathematical perception of the primary term.

The last two equations (196c,d) acquire in the conventional differential presentation the following form:

$$\frac{\partial^2 \mathsf{E}}{\partial x^2} = \frac{1}{c^2} \frac{\partial^2 \mathsf{E}}{\partial t^2} \qquad (170)$$

$$\frac{\partial^2 B}{\partial x^2} = \frac{1}{c^2} \frac{\partial^2 B}{\partial t^2} \qquad (170a)$$

Thus the two Maxwell's equations appear to be derivations of the wave equation (2.4, (61) & (62)) for a **plane** (area) electromagnetic wave. However, this does not mean that the electromagnetic waves are really plane, but that the geometric approach departing from the $LRC = c^2$ of photon space-time automatically results in a [2*d-space*]-presentation of the electromagnetic level of photon space-time. Within geometric formalism, the electric field and the magnetic field are regarded as superimposed waves that oscillate in phase with the same frequency. When equations (170) and (170a) are rearranged, we obtain a simple relation:

$$\mathsf{E} = Bc = [1d\text{-}space\text{-}time]\ f = acceleration = a \qquad (171)$$

The electric field E around an electric system of matter is $B = f$ times greater than the one-dimensional space-time of the photon level. As both the electric field and the magnetic field are presented as perpendicular vectors, the direction of propagation of the resultant electromagnetic wave (U-set) is the direction of the cross product $\mathsf{E} \times B$ (geometry of photon space-time). However, we should be aware of the fact that geometry is a posterior method of presenting space-time, and does not enlarge our knowledge of the primary term, that is, of the physical world. Any true knowledge can only be acquired in philosophical-logical categories. Mathematics is a secondary instrument for the precise presentation of space-time.

4.14 THE WAVE EQUATION IS THE DIFFERENTIAL FORM OF THE UNIVERSAL EQUATION

In the previous chapter we have shown that the two Maxwell's equations (170) and (170a) are applications of the classical wave equation (61) for photon space-time by setting the square speed of light as the *LRC* of this level $LRC = U_U = c^2 = \mathsf{v}^2 = [2d\text{-}space\text{-}time]$ (62). From this we come to the following important conclusion:

> The **wave equation** is the **differential form** of the universal equation:

$$E = LRC = \frac{\partial x^2}{\partial t^2} = \partial x^2 \partial f^{\,2} =$$

$$= \mathrm{SP(A)}[2d\text{-}space\text{-}time] = [2d\text{-}space\text{-}time],$$

$$\text{when } \mathrm{SP(A)} = 1 \qquad (172)$$

It can be applied to any level of space-time, such as material levels (optics, acoustics), electromagnetic level of photon space-time (electromagnetism), and microscopic particle levels (Schrödinger wave equation of quantum mechanics).

The method of definition of various physical quantities that are presented as [2*d-space-time*]-quantities is differential calculus as employed in Nabla and Laplace operators (4.6). Due to the frequent two-dimensional presentation of the primary term within mathematical formalism according to AR, one can obtain the 1*st* and 2*nd* derivative of this quantity with respect to time or space. This is the method of definition of Schrödinger wave equation. Here, we shall present some frequent quantities of electromagnetism that are obtained from the primary term by the method of differential calculus. The **energy density** η_e of the electromagnetic wave is a common quantity which is obtained by gradient-building from the electromagnetic energy:

$$\eta_e = \nabla\, E = \nabla\, hf = \nabla\, LRC = [2d\text{-}space\text{-}time]\ /[1d\text{-}space] =$$

$$= [1d\text{-}space\text{-}time]\ f = \mathsf{E},\ a \qquad (173)$$

The energy density has the dimensionality of the electric field or acceleration and is thus not identical with the classical density (47). This example illustrates the confusion which one finds in physics - the quantities are introduced in a chaotic manner within mathematics without making any effort to organize them in an axiomatic system. This is the major deficiency of this discipline, as can be proven by further expressions of the energy density, which do not reveal the differential method at first glance:

$$\eta_e = \mathsf{E}, a = \frac{1}{2}\varepsilon_0 \mathsf{E}^2 = \frac{\mathsf{E}^2}{2\mathsf{E}_0} = [1d - space - time]\, f \qquad (174)$$

This equation (RT) is often used in quantum mechanics. It is also applied to obtain the **magnetic density** in a tautological manner:

$$\eta_m = \mathsf{E}, a = \frac{B^2}{2\mu_0} = \frac{(\mathsf{E}/c)^2}{2\mu_0} = \frac{\mathsf{E}^2 l_{\mu_0}}{2c^2} = \frac{\mathsf{E}^2}{2\mathsf{E}_0} = [1d - space - time]\, f \qquad (175)$$

From equations (174) and (175), the **electric** and **magnetic density** of the electromagnetic waves (photons) are obtained as U-sets:

$$\eta_e + \eta_m = \varepsilon_0 \mathsf{E}^2 = \frac{\mathsf{E}^2}{\mathsf{E}_0} = \frac{B^2}{\mu_0} = B^2 l_{\mu_0} = \frac{\mathsf{E}B}{\mu_0 c} = \frac{\mathsf{E}Bl_{\mu_0}}{\lambda_A} \qquad (176)$$

The above equations illustrate the redundant, pleonastic character of physical mathematics. This also holds for the quantity „**Poynting-vector**“:

$$S = \frac{\mathsf{E} \times B}{\mu_0} = \mathsf{E} \times B.\, l_{\mu_0} = [2d - space - time] f = Ef = E_A f = E,$$

$$\text{when } E = E_A, \text{ and SP(A)} = 1 \qquad (177)$$

These exercises can be continued *ad infinitum* - mathematics, being an adequate perception of space-time, has the infinite capacity to produce new terms, just as space-time has the infinite capacity to produce new levels of space-time. This same tendency of space-time is also manifested by human consciousness, which is a mirror image of space-time.

5. QUANTUM MECHANICS

5.1 BOHR MODEL OF ENERGY QUANTIZATION ANTICIPATES THE INHOMOGENEITY OF SPACE-TIME (ND)

While the **special theory of relativity** was established by **Einstein** at a stroke around 1905, the foundations of **quantum mechanics** were gradually laid by him (explanation of the photoelectric effect) and by many other physicists between 1905 and 1926 (Schrödinger, Heisenberg). It is remarkable that the origins of quantum mechanics were not in the discoveries of radioactivity or atomic spectra, but in thermodynamics, or more precisely, in the interpretation of the laws of radiation which assess the vertical energy exchange between the thermodynamic level of matter and photon space-time.

Based on the concept of blackbody radiation as employed in Stefan-Boltzmann law (80,a), the historical **Rayleigh-Jeans law** was derived in a classical calculation of thermodynamics describing the homogeneous distribution of the power of radiation with respect to the wavelength as assessed by Wien's displacement law $P(\lambda,T) = 8\pi kT\lambda^{-4}$. When this law was applied to short wavelengths, it rendered infinite amounts of radiated photon energy, called the **ultraviolet catastrophe.**

In 1900, Planck acquired through pure deduction a novel presentation of this law by assuming a **finite, constant quantity of photon energy** - the **Planck's constant** h - and thus eliminated the ultraviolet catastrophe as a mathematical artefact. In the new axiomatics, we call this elementary amount of energy the **basic photon** or the **basic action potential** of the photon level. It is the universal reference system to which all space, time, and space-time relationships (e.g. as mass) can be compared as real physical quantities according to PCA. Planck's equation $E = hf$ gave birth to the idea that **space-time is quantized**, that is, **discrete (inhomogeneous)**. This philosophical concept builds the foundation of quantum mechanics, including the Bohr model, Schrödinger wave

equation, QED, QCD, and GUT. **Planck's** famous **equation of photon energy**:

$$E = hf = E_A f = m_p c^2 = \text{SP(A)}[2d\text{-}space\text{-}time] \tag{178}$$

is an application of UE for the photon level. Using this equation, Einstein explained the **photoelectric effect**. He departed from the vertical energy exchange between the electron level of matter and the photon level, which was experimentally found to be quantized (Hertz, 1887; Lenard, 1900). When the intensity of light of a given frequency is increased, more photons fall on the surface per unit of time, but the energy absorbed by each electron is unchanged. If ϕ (should not be confused with magnetic flux) is the energy necessary to remove an electron from a metal surface, the **maximum kinetic energy** of the electron is given by **Einstein's photoelectric equation**:

$$(1/2mv^2)_{\max} = eV_0 = hf - \phi = dE = \text{SP(A)}[2d\text{-}space\text{-}time] \tag{179},$$

where V_0 is called „stopping potential" and ϕ „work function". Equation (179) presents the two levels which participate in this vertical energy exchange as open entities. It also determines the borderline conditions, under which electrons are ejected and build a distinct level of kinetic electrons. These conditions are assessed by the magnitudes of the two constituents of photon space-time - **threshold frequency** f_t and **threshold wavelength** λ_t:

$$\phi = hf_t = \frac{hc}{\lambda_t} = E_A f_t = E_A \frac{v}{\lambda_t} = \text{SP(A)}[2d - space - time] \tag{179a}$$

The photoelectric effect was further supported by the discovery of **x-rays** by Röntgen. When electrons interact with a material system, they produce a specific **Bremsstrahlung spectrum** (braking radiation). Its **cutoff wavelength** λ_m is assessed by the above equation (179a):

$$\lambda_m = \frac{hc}{E} = \frac{hc}{eV} = [1d - space] \tag{179b}$$

Further evidence for the vertical energy exchange between the electron level and the photon level was furnished by **Compton** in a key experiment, measuring the scattering of x-rays by free electrons. In 1.9 we have departed from the axiom of CAP and expressed the classical equation of **Compton scattering** in the new space-time symbolism. From this experiment we have determined the mass of the basic photon $m_p = 0.737\times10^{-50}$ kg (45b), which is a novel fundamental constant obtained for the first time in conjunction with the discovery of the Law (see also Table 1).

These scattered experimental data called for a general model that could explain the various quantum effects. In 1913, **Bohr** proposed a **model** of **energy quantization** for the **hydrogen atom** that had spectacular success in calculating the wavelengths of the lines of known hydrogen spectrums (Balmer, Lyman, and Paschen series) and in predicting new lines. This model had a precursor - the **Rydberg-Ritz formula,** which gives the reciprocal wavelength as:

$$\frac{1}{\lambda} = RZ^2\left(\frac{1}{n_2^{\,2}} - \frac{1}{n_1^{\,2}}\right) \quad n_1 > n_2 \tag{180}$$

This formula is valid not only for hydrogen with the atomic number Z = 1, but also for heavier atoms of nuclear charge *Ze*, from which all electrons but one have been removed. The quantity *R* is called **Rydberg constant**. We shall show that it has the dimensionality of time $R = f$ and is thus constant for all series of an element. In quantum mechanics, it is usually given as the reciprocal wavelength $R_\infty = f = 1/\lambda = 1/[1d\text{-}space] = 10.97373\ \mu m^{-1}$. This presentation reflects the reciprocity of space and time.

Bohr proposed a mathematical model, which he developed by pure deduction. According to it, the negatively charged electrons revolve in a circular or elliptical orbit around the positively charged nucleus, similar to the planet's rotation around the sun. A Coulomb force of attraction is exerted between the two opposite charges. It acts on the electron like a centripetal force of gravitation. According to classical electrodynamics, such electrons are bound to lose energy and must collapse in a spiral orbit on the nucleus. Bohr eliminates this theoretical problem by postulating the **quantization** of **electron energy**. In his **first postulate**, he lets the laws of classical mechanics be valid within discrete energy levels:

„In an atom, the electron rotates in stable, non-radiating orbits called **stationary states.“** This idea of a closed system is not new, for it goes back to Kepler's laws describing the motion of planets around stable orbits (1.5).

The novelty of Bohr's approach is that he departs from Coulomb's law and not from Newton's law of gravity. In 1.7 we have shown that both laws are identical mathematical applications of the Law. In Bohr model, the electron is imagined as a charge point with a zero space that revolves around the nucleus in a circular orbit with the radius *r.* The geometric method of this model is cogent.

It is important to observe that at that time almost nothing was known about the composition of the nucleus, except that it was positively charged. In fact, Bohr postulated an equivalence between the electrostatic energy of the electron and its gravitational energy by considering them as U-sets. Mathematically, the model assumes an equivalence between the Coulomb force F_{el} and the centripetal gravitational force of Newton F_g, with which the vertical energy exchange between the two systems, electron and nucleus, is assessed:

$$\frac{m_e \mathsf{v}^2}{r} = \frac{e^2}{4\pi\varepsilon_0 r^2} \rightarrow \frac{m_p f_{c,e} \mathsf{v}^2}{r} = \frac{\mathsf{E}_0 e q_p f_{c,e}}{4\pi r^2} \tag{181}$$

This is an application of CAP for this vertical energy exchange expressed by force as an abstract quantity of space-time. The above equation holds for the hydrogen atom with a nucleus of one proton and the charge (area) of $+e$. We can rearrange equation (181):

$$4\pi m_p \mathsf{v}^2 r = \mathsf{E}_0 q_p{}^2 f_{c,e} \tag{181a}$$

When we solve equation (181a) for the electron velocity v, which is a tangential velocity, we obtain the kinetic space-time of the electron as its *LRC*:

$$\mathsf{v}^2 = \frac{e^2}{4\pi\varepsilon_0 m_e r} = \frac{\mathsf{E}_0 q_p{}^2 f_{c,e}}{4\pi m_p r} = [2d - space - time] =$$

$$= LRC_{kin} = constant \tag{182}$$

Equation (182) reveals that the kinetic space-time of the electron depends exclusively on the space-time magnitudes of the basic photon h given as charge q_p and mass m_p, as well as on the electric field of the photon level E_0. The Compton frequency $f_{c,e}$ can be regarded as the **intrinsic time** f_{in} of the electron, which is a specific microscopic system $f_{c,e} = f_{in}$. We have shown that this quantity depends on the space-time of the basic photon $f_{c,e} = e/q_p$ = SP(A) (98). Just as the intrinsic time of the electron is a function of photon space-time, so also is the second constituent of this microscopic system - the so called **Bohr radius a_0**. We shall derive this constant in (191). Throughout this elaboration of the basics of quantum mechanics, a ubiquitous fact emerges that should be noted at this point: all mathematical presentations of quantum systems can only give the space and time magnitudes of the systems as **constants** (constant space-time of the parts).

In his **second postulate**, which is a logical consequence of the first postulate, Bohr rules out the radiation of photons in the stationary states. The atom, or more precisely, the electron, radiates only when the electron makes a transition from one stationary state to another. The frequency of the emitted photons is related to the energy of the orbits and is set in comparison to the energy of the basic photon (PCA):

$$f = \frac{E_1 - E_2}{h} = \frac{dE}{h} = \frac{E}{E_A} = \text{SP(A)} \tag{183}$$

Equation (183) is an application of the Law for the level of emitted photons. It assesses the vertical energy exchange from the atomic level of matter to the photon level. It can be interpreted in terms of CAP: $hf = E_p = \Delta E_e$. Based on these two postulates, Bohr's objective is to find a general solution of Rydberg-Ritz formula that has been proven to be valid in the prediction of spectral lines. For this purpose, he sets the kinetic space-time of the electron (182) equal to the total energy of the electron (CAP). By rearranging the above equations, he obtains for the **time** of the **emitted photon** the following equation:

$$f = \frac{dE}{h} = \frac{e^2}{8\pi\varepsilon_0 h}\left(\frac{1}{r_2} - \frac{1}{r_1}\right) = K\left(\frac{1}{r_2} - \frac{1}{r_1}\right) \tag{184}$$

Equation (184) is solved for the hydrogen atom (Z = 1). The product in front of the parenthesis is a constant, because it constitutes constant quantities. This constant *K* can be expressed in many different ways, such as:

$$K = \frac{e^2}{8\pi\varepsilon_0 h} = \frac{\mathsf{E}_0 e^2}{8\pi m_p c^2} = \frac{q_p{}^2 f_{c,e}{}^2}{8\pi m_p l_{\mu_0}} = etc. = \mathsf{v} =$$

$$= [1d - space - time] = constant \tag{184a}$$

As we see, this constant is [1*d-space-time*]-quantity assessing the constant energy of the emitted photons during a transition of the electron from one stationary state to another. This transition can be regarded as a horizontal energy exchange - our degree of mathematical freedom allows us to describe the two stationary states as distinct systems of the electron level that interact (AR). Similar to the tangential velocity of the electron, the above constant depends only on the space-time magnitudes of the photon level. When this constant is divided by the difference of the radii of the two stationary states, we obtain the time of the emitted photons as a frequency:

$$f = \mathsf{v}/dr = [1d\text{-}space\text{-}time]/[1d\text{-}space] = f \tag{184b}$$

Equations (184a and (184b) are iterations of UE as presented in Bohr's second postulate (183). At this point, **Bohr's third postulate** is introduced. It says: „The angular momentum *L* of the electron revolving in a circular stationary orbit has **discrete** values". Bohr expresses this intuitive perception of the inhomogeneity of space-time mathematically with respect to the basic photon. The method of definition is geometry (24):

$$L = m\mathsf{v}r = nh/2\pi = E_A \tag{185}$$

This is an application of UE for rotations (1.4). The number *n* is defined by Bohr *a priori* as an **integer** that belongs to the continuum of closed real numbers (definition by abstraction). Since then, quantum theory has failed to give a proof as to why this number should be an integer. It is introduced in an abstract way and is thus a pure product of the free will of mathematical consciousness. This number embodies the human pref-

erence for closed real numbers over transcendental numbers. The closed real numbers are introduced by the method of definition of physical quantities and only then experimentally confirmed by the same method of measurement (circulus viciosus). This observation is of eminent importance for a proper epistemological understanding of quantum physics and its theoretical problems.

Equation (185) reveals that Bohr model is an application of the Law for rotations. In this sense, the electron and all other quantum systems are regarded as **superimposed rotations**, whereby each rotation is a source of a wave and vice versa (**wave character** of matter). This is the vested paradigm behind all presentations of quantum physics, such as Schrödinger wave equation, QED, and QCD. This fact has been obscured by the various mathematical methods, such as statistics, differential and integral calculus, exponential calculus, and modern geometric methods, which are simultaneously employed in quantum mechanics. The origin of these mathematical operations is the Law assessing the nature of spacetime. From a geometric point of view, rotations can be formally described by closed [1*d-space*]-quantities, such as circumferences, or by open [1*d-space*]-quantities, such as straight lines. For instance, the radius of a circular orbit is an open [1*d-space*]-quantity.

If we now interpret Bohr's third postulate of energy quantization of the electron in terms of rotation (185) by resorting to de Broglie's wave-particle dualism, we can exchange the linear momentum $m\mathsf{v}$ of the angular momentum $L = m\mathsf{v}r$ with the quotient $h/\lambda = E_A/\lambda = m\mathsf{v}\lambda/\lambda = m\mathsf{v}$ (tautology of quantities). In this case, we obtain the following simple relation:

$$n\lambda = 2\pi r = C = [1d\text{-}space] \qquad (185a),$$

where C is the **circumference** of Bohr stationary orbit of the electron. **De Broglie's interpretation** of Bohr's quantization condition (3*rd* postulate) is based on the idea that the electron is a **standing circular wave** - its circumference corresponds to the stationary orbit of the electron. Thus Bohr's third postulate can be rewritten as follows:

$$n\lambda/2 = \pi r = C \qquad (185b)$$

Equation (185b) describes the **standing wave condition** (58) for a circular wave as discussed in 2.3. Bohr uses this equation to calculate Bohr

radius and Rydberg constant. We shall now analyse the rational method of calculation behind Bohr model in the light of the Law.

Bohr follows the intuitive notion of the reciprocity of space and time and determines the actual magnitudes of the two constituents for the system „electron in an atom“ according to PCA. The angular momentum of the electron, which was originally regarded as a mass point (zero space), is, in fact, the action potential of this rotational system $L = m\mathsf{v}r = nh/2\pi = E_A$. In Bohr's third postulate (185), the **electron's action potential** is given as $E_A = 2\pi L$ = SP(A)[2*d-space*] *f*, whereas π = SP(A):

$$E_A = 2\pi L = 2\pi m\mathsf{v}r = 2\pi mr^2\omega = nh \qquad (185c)$$

As already pointed out in chapter 1.4, the two quantities of rotations, v and ω, are defined in physics in an ambiguous manner and can be potentially misinterpreted. The tangential velocity $\mathsf{v} = \omega r$ has the dimensionality of an action potential of rotation $E_{A,rot}$ (19). Notwithstanding this fact, the angular velocity, which is [1*d-space-time*]-quantity (17), is conventionally presented as a number $\omega = d\Theta/dt = f$ (angular frequency), because the angle is normally given as a number. These are basic inconsistencies that obscure the epistemological explanation of the mathematical procedures employed in quantum physics. Because of these inconsistencies, the tangential velocity is usually presented as [1*d-space-time*]-quantity: $\mathsf{v} = \omega r = f$ [1d-space] = [1*d-space-time*].

This clarification is the key to a proper interpretation of Bohr's third postulate. The product mr^2 in equation (185c) is defined as the moment of inertia $I = mr^2 = K_s = area$ = SP(A)[2*d-space*] (22). In Bohr model, this quantity is conventionally presented as a mass particle with "zero" space that revolves in Bohr stationary orbit. In the new axiomatics, the electron is regarded as a space-time system with a constant real space, which can be described one-dimensionally by its circumference *C* within geometry. In Bohr model, the moment of inertia of the electron is regarded as the certain event: $I = mr^2 = K_s = area$ = SP(A)[2*d-space*] = SP(A) = 1. In this case, the intrinsic time of this system should also be defined as the certain event f_{in} = SP(A) = 1. In this sense, the moment of inertia of the electron is the static expression of the **intrinsic action potential**, that is, of the **intrinsic angular momentum** L_{in} of the electron:

$$m_e r^2 = m_e r^2 f_{in} = \text{SP(A)}[2d\text{-}space]\ f = L_{in} = E_{A,in} \qquad (186)$$

Equation (186) is obtained consistently within the classical mechanics of rotations as expressed in the new space-time symbolism. We can now set for the intrinsic time of the electron its Compton frequency, and define this quantity as the **certain event**:

$$f_{in} = f_{c,e} = \text{SP(A)} = 1$$

This is the degree of mathematical freedom also used by Bohr. When we set the intrinsic action potential from equation (186) in Bohr's third postulate as given in (185c), we obtain the following result:

$$nh = 2\pi m_e r^2\, \omega = 2\pi E_{A,in}\omega = 2\pi L_{in} 2\pi f_{ex} = 4\pi^2 E_{A,in}\, f_{ex} =$$

$$= \text{SP(A)}[2d\text{-}space\text{-}time] = E \qquad (187)$$

In this equation, the external angular velocity of the electron is regarded as a revolving mass point. In Bohr model it is expressed by the **external time** f_{ex} of this particle, where $4\pi^2 = \text{SP(A)}$. We conclude:

> The equation of **Bohr's third postulate** is a concrete application of UE, $E = E_A\, f$, for the electron as a **superimposed rotation,** respectively, as a **circular standing wave**. The electron is regarded as the resultant system of an interaction between the **inner (intrinsic) rotation** and the **external (extrinsic) rotation** of the electron according to AR:

$$L = nh = E_{A,in}\, f_{ex}\,, \text{ when } 4\pi^2 = \text{SP(A)} = 1 \qquad (187a),$$

Equation (187a) is an application of CAP. From this, we arrive at the new interpretation of Bohr's third postulate:

> As the **basic action potential of the photon level** h is completely transformed into the **inner action potential** (intrinsic angular momentum) of the **electron**:

$$E_{A,in} = L_{in} = h \qquad (187b),$$

the **external time** f_{ex} of the electron, which is assessed by the angular frequency of the electron as a revolving mass point, is set in an *a priori* manner equal to the **continuum of natural integers *n***.

$$f_{ex} = n = \text{continuum of natural integers} \tag{188}$$

Equation (188) demonstrates repeatedly the priority of mathematical consciousness over empiricism - all quantities introduced in physics are objects of thought defined within mathematics and then confirmed in expensive and redundant experimental research. The third Bohr's postulate is thus an application of PLE - space-time = continuum - for the electron as a particular system of space-time. It is quite obvious that we might as well build this equivalence with the continuum of transcendental numbers. In fact, we must do this, in order to overcome the inherent shortcomings of Bohr model.

When the resultant angular momentum L of the electron is set in relation to the basic photon (PCA), the resultant time of this quantum system is conventionally defined as **quantum numbers**:

$$\frac{L}{\hbar} = \sqrt{l(l+1)} = \text{SP(A)} = f$$

In this case, $n = 1,2,3...$ is the **primary quantum number**, $l = 0,1,2,...$ n–1 is the **quantum number** of the **angular momentum**, and $m = -l, -l+1, -l+2, ..., +l$ is the **magnetic quantum number**. These mathematical pleonasms of the time magnitudes of the electron level(s) in the atom (atomic level) play a key role in the traditional view of quantum mechanics. In reality, they appear to be subsets of the continuum of closed real numbers, which is the current equivalent mathematical expression of space-time in physics. If we now substitute the external time f_{ex} with n in the above equations and rearrange them accordingly, we obtain the following relationship between the **external tangential velocity** v of the electron and the continuum of integers n:

$$\mathsf{v}_{\mathsf{ex}} = \frac{h}{2\pi m_e r} n = \frac{m_p \lambda_A{}^2}{2\pi m_p f_{c,e} r} n = \frac{\lambda_A{}^2}{2\pi f_{c,e} r} n \tag{189}$$

In any given stationary orbit with the radius r, the one-dimensional space-time of the electron depends only on the continuum of integers $v_{ex} \approx n$ because the quotient in front of the velocity is a constant. The magnitude of this constant is determined by the constant space-time of the basic photon. In fact, equation (189) is an application of the Law as an RT: $v = (\lambda_A{}^2/2\pi r) \times (f_{ex}/f_{c,e})$. It simply compares the space (r) and time (f_{ex}, $f_{c,e}$) quantities of the electron as the basic action potential of this level with that of the basic photon when its wavelength and frequency are defined as reference units: λ_A, $f_p = 1$. However, equation (189) has a deeper meaning. We can rewrite the term $2\pi f_{c,e} r$ to obtain the **intrinsic tangential velocity** v_{in} of the electron:

$$2\pi f_{c,e} r = \omega r = v_{in} \tag{189a}$$

If we express the basic photon in the numerator of equation (189) with the speed of light $h = m_p c^2$ (44) and rearrange this equation, we obtain the product of the **intrinsic** and **extrinsic tangential velocity** (AR) as a function of the reference speed of light:

$$v_{ex} v_{in} = c^2 n \tag{189b}$$

Equation (189a) tells us simply that the **aggregated tangential velocity** v_a of the electron, which is regarded as a superimposed rotation, is n **times greater than the square speed of light**:

$$v_a = c^2 n \tag{189c}$$

This is a remarkable result that topples another basic paradigm of traditional physics, or more precisely, of the theory of relativity, which postulates that the speed of light is the maximum speed we can observe in the physical world. How can this „change of paradigms“ be digested by the conventionally thinking physicist? Very easily. The knowledge that all elementary particles, such as the electron, have a bigger aggregated tangential velocity, that is, one-dimensional space-time, than the basic photon is a logical consequence of the reciprocity of space and time, respectively, of energy and space :

$$E \approx f = 1/[1d\text{-}space]$$

The greater the energy (space-time) of a system, the smaller its space (extent). Had this been known earlier, the standard model would not have been developed. It is, indeed, an act of revelation to confirm each time the validity of the new axiomatics of the Law. Its consistency and lack of contradiction is a reflection of the consistency of the real physical world - the existence of one single Law. This consistency is reflected by the present physical axiomatics.

Equation (189c) illustrates the reciprocity of space and time. The Compton wavelength is exactly $f_{c,e}$-times smaller than the wavelength of the basic photon: $f_{c,e} = \lambda_A/\lambda_{c,e} = 1.235589\times10^{20}$. Any space-relationship which we obtain for any two systems of space-time gives us the reciprocal of the energy relationship or mass between these two systems, for instance, $f_{c,e} = m_e/m_p$ (45). The same is true for the reciprocal of the corresponding time relationship $f_{c,e} = f_{c,e}/f_p = f_{c,e}/1$ (RT). The above relationships also hold for the *LRCs*:

$$\frac{\mathsf{v}_{ex}\times\mathsf{v}_{in}}{c^2} = \frac{\mathsf{v}_a}{c^2} = \frac{LRC_e}{LRC_p} = \frac{U_e}{U_U} = \mathrm{SP(A)} = n \qquad (189d)$$

This new presentation of Bohr's third postulate confirms that in the past any physicist who has possessed a modicum of mathematical thinking has automatically assessed the Law in an intuitive manner in his particular area of interest. This will be illustrated for Bohr. When we set the external tangential velocity v_{ex} from equation (189) in equation (182), we obtain the following relationship between the **radius *r*** of the electron orbit and the continuum of the natural integers *n*, that is, the external time of the electron $f_{ex} = n$:

$$r = \frac{m_p\lambda_A^{\,4}}{\pi\mathsf{E}_0 q_p^{\,2} f_{c,e}^{\,3}} n^2 \qquad (190),$$

where $m_p = 0.737\times10^{-50}$ kg is the mass of the basic photon, $\lambda_A = 2.99792458\times10^8$ m is the wavelength of the basic photon, $\mathsf{E}_0 = 1/\varepsilon_0 = 0.11294\times10^{12}$ ms^{-2} is the electric field of the photon level, $q_p = 1.29669\times10^{-39}$ m^2 is the charge (area) of the basic photon, and $f_{c,e} = 1.235589\times10^{20}$ s^{-1} is the Compton frequency of the electron. All these quantities are **new** constants, which we have obtained for the first

time by employing the new axiomatics of the Law.

When we calculate the quotient in front of n for the hydrogen ($n = 1$ and $Z = 1$), we acquire **Bohr radius** a_0, which is a fundamental [1*d-space*]-constant of quantum mechanics:

$$a_0 = \frac{m_p \lambda_A^{\ 4}}{\pi \mathsf{E}_0 q_p^{\ 2} f_{c,e}^{\ 3}} = 0.0528995 \times 10^{-9}\,\mathrm{m} \tag{191}$$

The general formula of Bohr radius is given as follows:

$$r = \frac{a_0}{Z} n^2 = \frac{a_0}{Z} f_{ex}^{\ 2} \tag{192}$$

It says that the radius of the electron stationary orbit is proportional to the **square of integers**, that is, to the square external time f_{ex}. The second fundamental constant of classical quantum mechanics is, as expected, a time quantity - the Rydberg constant $R = f$ (180). Based on these two quantities of the electron, Bohr could easily derive Rydberg-Ritz formula (180) from his original equation (184) of the second postulate (194b).

Equation (194b) says that the frequency of the emitted photons is inversely proportional to n. In Bohr model, the stationary orbits of the electron are designated with the primary quantum number $n = 1,2,3....$, beginning with the orbit next to the nucleus. In this formalistic procedure, Bohr uses the continuum of integers simultaneously as the **set of ordinal numbers** (numerals) $n = 1st, 2nd$, etc. and the **set of cardinal numbers** (cardinal numerals) $n = 1,2,3...$This fact of extreme epistemological importance has so far evaded the attention of physicists.

The knowledge that the radius of the electron orbit behaves proportionally to the square of the integers $r \approx n^2$ (192) has been celebrated as a great achievement of theoretical physics. It builds the foundation of modern quantum mechanics, which describes the fine structure of matter in terms of **quantum numbers**. However, our epistemological analysis reveals that this „discovery“ is an application of PLE within mathematics. We shall prove this below.

We have shown that electric charge is defined as the cross-sectional area of the particles in motion (4.2). In real terms, it is of minor importance whether this area is defined as the square circumference $Q = u^2 = 4\pi^2 r^2 = \mathrm{SP(A)}$[2*d-space*] or the area of a circle $A = \pi r^2 =$

= SP(A)[2*d-space*]. In both cases, the charge of the particle is proportional to its [2*d-space*], which can also be expressed by the diameter d = [1*d-space*]. This degree of mathematical freedom is independent of the actual form of the system - it holds in any system or level.

Precisely for this reason, we define K_s = SP(A)[2*d-space*] as the **universal formula** of applied geometry. It is based on AR within Euclidean space or any other geometric space that is equivalent to it (transitiveness of mathematics). The charge (area) of any particle is a specific constant of its constant space-time. In real terms, this would say that the electron has the same cross-sectional area for all stationary orbits, independent of the radius of the orbit. When the paradigm „charge (area) in motion (rotation)“ is applied, this means that the cross-sectional area of the electron can be presented as a function of time $I = dQ/dt = K_s f = E_A$. If we define the electron as the basic action potential of the electron level of an atom $E_{Ae} = I_e$, we can easily assess it as a product of its cross-sectional area and time:

$$E_{Ae} = I_e = Q\, f = A\, f = \pi r^2 f \tag{193}$$

Let us now take two electrons with the radii, r_1 and r_2, as two equivalent basic action potentials of the electron level. Their times are given as f_1 and f_2. When we apply the axiom of CAP, we obtain:

$$E_{Ae1} = \pi r_1^2\, f_1 = E_{Ae2} = \pi r_2^2\, f_2 \tag{193a},$$

When we present (193a) as an RT, we obtain the **reciprocity of charge (space) and time**:

$$\frac{r_1^{\,2}}{r_2^{\,2}} = \frac{\left[2d - space\right]_1}{\left[2d - space\right]_2} = \frac{charge_1}{charge_2} = \frac{f_2}{f_1} \tag{194}$$

We can now set for the radius of the first orbit next to the nucleus the number $r_1 = n = 1$ as the certain event or a numeral $r_1 = n = 1st$, as is done in Bohr model. Accordingly, we must write for the time $f_1 = n = 1$ as the certain event, 1 *unit*, or the *first numeral*:

$$\frac{1}{n^2} = \frac{f_2}{1} = f_2, \text{as } f_1 = 1 \text{ and } r_1 = 1 \tag{194a}$$

This simple derivation of UE as an RT can be interpreted as follows: the time of the electrons is inversely proportional to the square of the natural integers. This is an iteration of the inverse-square laws of nature, which are products of the two-dimensional presentation of space-time within geometric formalism. When Rydberg-Ritz formula is presented according to Bohr's postulates, we obtain for the time of the electron f_{ex} the following new equation:

$$f_{ex} = \frac{f_p}{R} = \left(\frac{1}{{n_2}^2} - \frac{1}{{n_1}^2} \right) \tag{194b}$$

In equation (194b), the time of the electron is assessed as a quotient of the frequency of the emitted photon f_p and the Rydberg-constant, which has the dimensionality of time (PCA). Both equations, (194a) and (194b), are equivalent applications of UE for the electron. Rydberg-Ritz formula assesses the vertical energy exchange between the electron level and the photon level in terms of time (PCA).

The use of the continuum of integers as quantum numbers has justifiably evoked the doubt among physicists that quantum mechanics is „not a true empirical discipline", as is still believed with respect to classical mechanics and electromagnetism, but a „mere mathematical formalism". As scientists have not been able to develop a coherent axiomatics based on the theory of knowledge, they still use this mathematical formalism and compound its complexity of presentation by inventing new formulae. In their epistemological helplessness, they have resorted to additional non-mathematical interpretations, such as **Heisenberg uncertainty principle,** and have thus introduced new interpretational flaws into modern physics (5.3). Physics, being applied mathematics, and mathematics, being a hermeneutic discipline of consciousness that exhibits an infinite propensity to evolve, have not only been the chief source of scientific knowledge, but also an intellectual trap for physicists. The growing complexity of the mathematical instruments which they have introduced in physics has obscured the objective existence of the Law. Any analysis of this fact must inevitably include the psychological and intellectual make-

up of the scientist at the end of the Second Millennium; he is essentially a product of negative social adaptation.

5.2 SCHRÖDINGER WAVE EQUATION OF QUANTUM MECHANICS IS AN APPLICATION OF THE UNIVERSAL EQUATION (ND)

In 1924, **de Broglie** suggested that electrons may have wave properties. Since electromagnetic waves were known to behave as waves (Maxwell's electromagnetism) and particles (Planck's equation), it was quite logical to expect the same characteristics for matter. Departing from Planck's equation, de Broglie presented the following application of UE as an RT:

$$\lambda = \frac{c}{f} = \frac{hc}{hf} = \frac{hc}{E} = \frac{hc}{pc} = \frac{h}{p} = \frac{\mathrm{SP(A)}[2d - space]f}{\mathrm{SP(A)}[1d - space]f} =$$

$$= [1d - space] \tag{195}$$

Although de Broglie's equation is applied to photon space-time, or more precisely, to the basic photon, it is generally believed to hold in matter - hence the concept of the **wave-particle dualism of matter.** The epistemological deficiency of this concept should be cogent to the reader. Tacitly, physicists have assumed that the properties of matter are determined by the properties of photon space-time. At the same time, they have continued to distinguish between matter with mass and energy without mass, that is, photon space-time, as is expressed in Einstein's equation $E = mc^2$.

Until now there has been virtually no effort to explain the vertical energy exchange between matter and photon space-time so as to include gravitation and electromagnetism. From equation (195) the kinetic energy $E_{kin} = 1/2m\mathrm{v}^2$ of low-energy electrons is calculated within mathematical formalism by introducing new quantities:

$$E_{kin} = \frac{m\mathrm{v}^2}{2} = \frac{m^2\mathrm{v}^2}{2m} = \frac{p^2}{2m} = \frac{\mathrm{SP(A)}^2[2d - space - time]}{2\mathrm{SP(A)}} =$$

$$= \mathrm{SP(A)}[2d - space - time] \tag{196}$$

We present this equation because it is basic to Schrödinger wave equation. From (196) we can obtain the non-relativistic momentum of the particle $p = \sqrt{2mE_{kin}}$ or the wavelength $\lambda = \frac{hc}{\sqrt{2mc^2E_{kin}}}$. Electrons with energies in the order of 10 eV thus have **de Broglie wavelengths** in the order of nanometers. This magnitude gives the size of atoms and the spacing of atoms in a crystal. When electrons with this energy interact with a crystal structure, they are scattered in a similar way as *x*-rays. This is a proof that matter is of wave character (electron diffraction and interference, Davisson & Germer, Thompson, 1927).

In the new axiomatics, we regard each wave as an action potential with a constant mean specific energy for each source and medium. The evidence that atoms have the same space as electrons confirms that all systems of space-time are U-sets that contain themselves as an element - the electron contains the nucleus with the hadrons (protons and neutrons), while the latter contain the quarks and so on. Precisely for this reason the electron level, which determines the crystal structure of matter, also determines the properties of the thermodynamic level - the thermodynamic behaviour (expansion, contraction) of materials depends on the energy exchange between these two levels (see kinetic theory of gases in 3.3).

In 1926, **Schrödinger** presented a wave equation of quantum mechanics that was analogous with the classical wave equation (61). With this equation he could describe the wave-particle character of particles, that is, of electrons, within mathematical formalism. Like the classical wave equation, Schrödinger wave equation of quantum mechanics is an application of UE. Schrödinger departs from the wave equation of electromagnetism (172) and arbitrarily selects the abstract quantity, **electric field**, that is, acceleration, as the basic quantity with which the space-time of the particle should be assessed. This is another heritage of electromagnetism ((174) to (177)). Historically, acceleration is the preferred quantity in physics - from classical mechanics to quantum mechanics, this pattern remains invariant. Within mathematics, this quantity assesses space-time as [1*d-space-time*] in the process of energy exchange, that is, in terms of time: $E \Rightarrow$ a, $\mathsf{E} = [1d\text{-}space\text{-}time]\, f = E_A\, f$, where $E_A = [2d\text{-}space]\, f = [1d\text{-}space]\, f = [n\text{-}d\text{-}space]\, f$. As any quantum action

potential can be given by the field of the particle, we can present any energy interaction between two quantum systems according to AR: $E = E_{A1}E_{A2} = \mathsf{E}_1\mathsf{E}_2 = \mathsf{E}^2$. Schrödinger defines the square electric field *a priori* as the **wave function** $|\psi|^2 = \psi \times \psi = \mathsf{E}^2$ of the particle. This quantity is then assessed by the method of statistics. As SP(A) = *n* = space-time, any statistical magnitude which we obtain from a statistical test performed in the real world is either space, time, or a space-time quantity. These quantities are the actual „expected values" of any statistical parameter. This also holds for the **wave function**:

$$|\psi|^2 = \mathsf{E}^2 = [2d - space - time]\, f^{\,2} \tag{197}$$

In terms of the theory of probability, this quantity is also called „**residence probability density of the photon"**, in German: „Aufenthaltswahrscheinlichkeitsdichte", which is, indeed, an awful word. It is important to observe that, until now, quantum mechanics has not been in a position to explain this term epistemologically. This is generally acknowledged - hence the feeling that quantum mechanics is a pure mathematical formalism, which is essentially true. In the new axiomatics, this problem is solved by explaining the nature of the primary term. In this process, we have proved that the probability set $0 \leq SP(A) \leq 1$ is equivalent to the primary term. Any subset of it, such as $|\psi|^2 = \mathsf{E}^2$, manifests the properties of space-time. Bearing this in mind, we can easily perceive the traditional non-mathematical interpretation of the residence probability density of the photon as „the probability of a photon to occur in a certain volume, e.g. in the volume of the electron."

In the traditional view of quantum mechanics, the space of the particle is regarded as void (vacuum); in this empty space the photon appears, so to say, out of „nowhere". The absurdity of this idea should be cogent to everybody. Furthermore, it is quite remarkable that although Schrödinger wave equation is derived for the particles of matter, **it actually considers the basic photon**. Does this mean that electrons do not exist, but are merely another spatial form of organisation of photon space-time? If so, photons must also have space (charge) and mass, just as all material particles have space and mass, the aggregated product of which is defined as electromagnetism and matter. Quantum physics does not give any clear answer to these essential questions. It has simply overlooked them.

In the new axiomatics, space-time is discrete, but continuous, so that

there is no vacuum. Any system of space-time can be regarded as a specific spatial configuration, for instance, as a standing wave, which contains space-time as an element. If we depart from the term „photon space-time“ as a synonym for space (extent), we must expect that photons form the space of particles. If we consider the vertical energy exchange between matter, that is, the particles of matter, and photon space-time, we must find the basic photon as an element in the particles (U-sets). This is the epistemological background of the statistical approach of Schrödinger wave equation, which, in the light of the new axiomatics, is a simple differential equation of the Law.

Within mathematical formalism, this equation renders **complex numbers** with the **imaginary unit** $i = \sqrt{-1}$ as a possible solution. As all numbers are „objects of thought“, this imaginary unit has no real correlate - it is a surrogate of mathematical operations. In the light of the new axiomatics, the epistemological origin of the imaginary number is very simple. We shall explain it for the first time in the history of science in a concise form because this aspect is closely related to current theoretical interpretations in quantum mechanics.

The application of AR in physics leads to the building of various square quantities within the established geometric formalism of Euclidean space, as demonstrated for the electric field above. As the physical quantities of the interacting systems are usually presented one-dimensionally as vectors, the resultant quantity is two-dimensional in terms of space, time, or space-time (197). If we now employ the axiom of reciprocal *LRC* of contiguous levels to express the reciprocity of space and time in mathematical terms, we can present any two-dimensional quantity, such as $|\psi|^2 = \mathsf{E}^2$, with the continuum of real numbers $|\psi|^2 = \mathsf{E}^2 = n = 1$ and its reciprocal counterpart with the continuum of negative numbers $|\psi|^2 = \mathsf{E}^2 = -n = -1$ (degree of mathematical freedom). This is a very common approach in physics (see examples above).

If we now build the **square root** of quantities, to which the number “–1“ is atributed in a primary manner, we obtain the **continuum of imaginary numbers** from the continuum of negative numbers $\sqrt{-1 \times n} = in$. Thus the imaginary unit *i* and the complex numbers which contain this unit as an element are an intuitively correct perception of the reciprocity of space and time. The proof of existence of imaginary numbers is the primary term. When Schrödinger wave equation is applied to the real world, the solutions that give complex numbers are eliminated by conven-

tion. This is a rare example of common sense in quantum mechanics.

As already stressed on many occasions, we can assess the two canonically conjugated constituents of space-time only after we have separated them mentally in our mind, that is, in mathematics, which is a hermeneutic discipline of mathematical consciousness. We have shown that this is the origin of differential and integral calculus. The same is true for statistics: we can assess space-time through a subset thereof (random sample), by determining either its space or time magnitudes. This is precisely the objective of Schrödinger wave equation. It acknowledges intuitively this epistemological background and describes the space-time of the particles either as a spatial (area) integral, by setting the time as the certain event $f = 1/dt = \mathrm{SP(A)} = 1$ (**time-independent Schrödinger equation**), or as a space-time function, by setting the time as a statistical variable $0 \leq f = 1/dt = \mathrm{SP(A)} = sin(kx - \omega t) \leq 1$ (**time-dependent Schrödinger equation**).

Schrödinger wave equation departs from the classical wave equation (58), which is now written for the electric field (acceleration) as a quantity of photon (electromagnetic) space-time ((172) - (176)):

$$\frac{\partial^2 \mathsf{E}(x,t)}{\partial x^2} = \frac{1}{c^2}\frac{\partial^2 \mathsf{E}(x,t)}{\partial t^2} = \frac{1}{LRC_p}\frac{\partial^2 \mathsf{E}(x,t)}{\partial t^2} \tag{198}$$

The space-time of the photon level is regarded as a harmonic wave, and is expressed by the cosine function (2.3). In equation (198), the square electric field can be differentiated twice with respect to time $f = 1/dt$ and space. When these derivatives are calculated in the cosine function, a simple relation is obtained between the angular velocity $\omega = [1d\text{-}space\text{-}time]$ (17) which is erroneously regarded as angular frequency $\omega = 1/[1d\text{-}space] = f$ and the wave number $k = 2\pi/\lambda = \mathrm{SP(A)}$ (55):

$$k = \frac{\omega}{c} = \frac{[1d - space - time]}{[1d - space - time]} = \mathrm{SP(A)} \tag{199}$$

Equation (199) illustrates that as soon as the new space-time symbolism is applied, we do not need the complex derivation by cosine function and differential calculus in (198) to acquire this simple relationship. We can

build it *ad hoc*. Equation (199) embodies the equivalence between rotations and waves: **rotation** = **wave**. Both are aspects of one and the same thing - energy exchange that manifests itself as a closed motion. There is no possibility of distinguishing between a rotation and a wave in real terms. This equivalence is the essence of the classical wave equation (2.4). Based on equation (199), the frequency (time) of the photons can be given in terms of the angular velocity:

$$f = \frac{c}{\lambda} = \frac{\omega}{2\pi} = \frac{[1d - space - time]}{[1d - space]} = f \qquad (199a)$$

This is a very useful application of UE as a RT. It is used to rearrange the equation of the total energy of an electromagnetic wave $E_{total} = E_{kin} + E_{pot}$ as follows:

$$E_{total} = hf = \frac{h\omega}{2\pi} = \hbar\omega = \frac{\hbar^2 k^2}{2m} + E_{pot} = \mathrm{SP(A)}[2d - space - time] \qquad (200)$$

When we substitute the *LRC* of the photon level in equation (198) with the total energy of the photons as given in equation (200), we obtain the **time-dependent Schrödinger equation** of quantum mechanics:

$$-\frac{\hbar^2}{2m}\frac{\partial^2\Psi(x,t)}{\partial x^2} + E_{pot}(x,t)\Psi(x,t) = i\hbar\frac{\partial\Psi(x,t)}{\partial t} \qquad (201)$$

This equation is called „time-dependent“, because the potential energy is expressed as a function of space and time $E_{pot}(x,t)$. In the classical tradition, the concept of potential energy reflects the static view of the world, which eliminates the energy exchange in an abstract way in the mind. In (201) this abstract subset of space-time is given as a function of time. This engenders serious theoretical problems in quantum mechanics. The objective is thus to arrive at a new formalistic presentation of Schrödinger wave equation in which the variable constituent time that gives the amount of energy exchange no longer appears.

What is the method that Schrödinger selected? The new axiomatics makes clear that the only way of eliminating time in an abstract way is to arrest time in the mind by defining it as the certain event $f = 1/dt =$

= SP(A) = 1 or 1 *unit*. Thus any mathematical procedure which eliminates time as a variable inevitably uses the primary number „1“. According to PLE, this number is equivalent to space-time. Schrödinger uses exactly this procedure to eliminate time and to acquire a time-independent wave equation. We shall unveil this complex procedure step by step, for it is a common method not only in physics, but also in pure mathematics. At first, the wave function is expressed in the **exponential form** by placing the conventional time in the exponent:

$$\Psi(x,t) = \psi(x)e^{-i\omega t} \tag{202}$$

Thus the wave function is artificially separated into a time-independent part ψ(x) and a time-dependent exponent of the constant $e^{-i\omega t}$. This is a frequent procedure leading to the derivation of various **exponential laws** as applications of UE (2.1, (53) - (53b)). In this form, the equation is still time-dependent. In a second step, the exponential is compared with itself (building of a relationship) and the certain event is obtained: $e^{-i\omega t}/e^{-i\omega t} =$ = SP(A) = 1. The actual procedure is as follows: Schrödinger wave equation is given in the exponential form and all terms are divided by the exponential. This is a common method in mathematics, which is an application of PCA:

$$-\frac{\hbar^2}{2m}\frac{\partial^2\psi(x)}{\partial x^2}e^{-i\omega t} + E_{pot}(x)\psi(x)e^{-i\omega t} = \mathsf{E}\psi(x)e^{-i\omega t} \Big| \ : e^{-i\omega t} \tag{203}$$

The result of this division is the **time-independent Schrödinger equation:**

$$-\frac{\hbar^2}{2m}\frac{d^2\psi(x)}{dx^2} + E_{pot}(x)\psi(x) = \mathsf{E}\psi(x) \tag{204}$$

Equation (204) is a simple differential presentation of UE using the method of divergence ((122) & (123)). The solutions of this equation are derivatives with respect to space dx^2 and are therefore **real** numbers (geometric presentation). Equation (204) solves for the potential energy in the **stationary case**:

$$|\Psi(x,t)|^2 = |\psi(x)|^2 \tag{204a}$$

In terms of statistics, this function is *a priori* defined as **continuous** (stetig), although no proofs are furnished for this assumption. Based on the nature of the primary term, we define space-time as continuous, but discrete. The concept of discontinuity involves the existence of vacuum, which has been axiomatically eliminated as an N-set. Classical quantum mechanics, on the contrary, is based on a paradox - on the one hand, it regards the basic photon as a mass point with a zero space that occurs in the empty space of the particle; on the other, it assumes that its spatial distribution in the particle is continuous. The absurdity of this outlook is self-evident. In practice, the solution of the time-independent Schrödinger equation is reduced to finding the **area integral** of the space of the particle that is awkwardly called the **residence probability density of the photon**:

$$\int_{-\infty}^{+\infty} |\psi(x)|^2 \, dx = \mathrm{SP(A)} = 1 = space \tag{205}$$

This equation is called the **standardisation condition** (Normierungsbedingung) of Schrödinger wave equation. In fact, it is a definition of the certain event for the space of any particle. To acquire this final result, we need not derive Schrödinger wave equation in the aforementioned complex manner. Equation (205) is an application of PLE for the microcosm. The building of equivalencies between the „1“ and the parts is a common mathematical method of physics. It reflects the only method of building mathematical equations according to PCA as an application of PLE. In the next chapter, we shall show that Heisenberg has used the same method to introduce his famous and highly overestimated „uncertainty principle“.

Before we discuss this principle in the next chapter, we shall finally prove that we can quite easily obtain Schrödinger's standardisation condition of the particle when we depart from the classical quantity of **density** $\rho = \mathrm{SP(A)}/[1d\text{-}space]$ (47). When we solve the probability SP(A) in this simple equation, we obtain an equation that is equivalent to (205):

$$SP(A) = \rho[1d\text{-}space] = 1 \tag{206}$$

This example illustrates the intrinsic capacity of mathematics to produce an infinite complexity of symbols, which can be axiomatically derived from UE as an RT.

5.3 HEISENBERG UNCERTAINTY PRINCIPLE IS AN INTUITIVE NOTION OF THE UNIVERSAL LAW

Heisenberg uncertainty principle was postulated at the same time as Schrödinger published his equation. Since then, it is considered to be the basic explanatory principle of quantum mechanics. Its interpretations are numerous and rather confusing. In this survey, we shall focus on the mathematical presentation of this principle. Heisenberg accepts uncritically the geometric approach of quantum mechanics as presented in Bohr model and Schrödinger wave equation. He regards the particles as mass points with zero space that rotate in empty space. According to classical mechanics, the initial conditions of such mass points can be exactly determined (initial-value problem). In chapter 1.1 we have proved that this is a false idea nurtured in the realm of mathematical formalism and has no correlate in the real world. All real systems of space-time have space and time, and any particular space of a system has a specific constant (finite) magnitude, which can be expressed with a number x belonging to the continuum of real numbers n, or with a probability belonging to the probability set SP(A), where $n = SP(A)$. Furthermore, we have unveiled why any probability obtained in the real world is space (geometric magnitude), time (dimensionless number), or space-time relationship (dimensionless number). This is the epistemological background of mathematics as embodied in the theory of sets. As physics is applied mathematics, this also holds for this empirical discipline. The proof of existence for both disciplines which are promulgated in the new axiomatics is that space-time (energy) and continuum are equivalent concepts of the primary term (PLE).

Heisenberg departs from the idea that particles behave as a **wave packet** as described in wave theory. We use the same approach to present the **action potential** as a **superimposed standing wave in motion** (2.5). The outstanding characteristic of a wave packet is that, when its duration

Δt becomes very short, the range of frequencies $\Delta\omega$ becomes very large. The product of the two quantities is usually set equivalent to 1 (certain event): $\Delta\omega\Delta t = 1$ (64). We have shown that the quantity „range of frequencies“ is a pleonasm of angular velocity. When this equation is expressed in the new space-symbolism $\Delta\omega\Delta t = [1d\text{-}space\text{-}time]/f = [1d\text{-}space] = SP(A) = 1$, we obtain the classical definition of the extent (space) of the wave packet that is assessed one-dimensionally as the certain event or 1 *unit*. This definition takes place within mathematics and can be applied to any wave packet (degree of mathematical freedom). We might as well set the above equation equal to any number or probability value, and it will still remain true.

This equation can be expressed in many different ways by using various abstract quantities (tautology of mathematics). For his principle, Heisenberg uses the classical quantity of mechanics, the momentum, or more precisely, its pleonastic expression - the impulse $I = \Delta p = F\Delta t = p = SP(A)[1d\text{-}space\text{-}time]$ (15). He establishes a reciprocal relationship between the impulse Δp and the time of collision (contact time) Δt on the one hand and the space of the wave packet (pulse) $\Delta x = [1d\text{-}space]$ on the other. In this case, the wave packet symbolizes a photon (an electromagnetic wave), which interacts in a vertical energy exchange with the particles of matter and allows the measurement of their space-time, for instance in Compton scattering. Heisenberg comes to the following conclusion: the greater the impulse of the wave packet or the shorter the time of collision between the wave packet (photon) and the particle, the more exact the determination of the location of the particle. The latter is regarded as a mass point with zero space that moves randomly in empty space.

Although this statement is an intuitively correct perception of the reciprocity of space and time (see below), it contains the classical flaw of physics that has prevented physicists from discovering the Law. The logical fallacy of Heisenberg uncertainty principle can be summarized as follows. According to the quantization idea of Bohr, that is expanded by Schrödinger in his wave equation, the particle residing in the empty space attributed to this particle (tautology) is not the particle itself, but the basic photon *h* as an element of the particle (U-subsets).

This observation might be embarrassing to traditional physics, but it is unavoidable for our further elaboration. As there is no vacuum, any real particle is **its own space in rotation**. The correct interpretation of Heisenberg’s conclusion should be: the greater the impulse of the pho-

ton, and the shorter the time of interaction between the photon and the particle, the smaller the space of the particle. This statement is identical to the axiom of CAP. This becomes obvious when we present the uncertainty principle in the mathematical form that has been chosen by Heisenberg (see also (200)):

$$\Delta p \Delta x = \mathrm{SP(A)}[1d\text{-}space\text{-}time][1d\text{-}space] = E_A = h\,f = h(\omega/2\pi) =$$

$$= (h/2\pi)\omega = \mathrm{SP(A)} = 1 \tag{207}$$

The particle that is regarded as an action potential and expressed as $\Delta p \Delta x$ is set equivalent to the interacting photon, which is regarded as E_A. In Heisenberg uncertainty principle, these two entities (AR) are not clearly distinguished - hence the confusion with the particle as the basic photon. Nevertheless, it is true that space-time is a U-set, which is contained as an element in all systems and levels. As space-time is incessantly exchanged between the systems, it is not possible to distinguish the space-time of photons from that of particles. Equation (207) is one possible expression of the axiom of CAP. Within mathematical formalism we can, for instance, set the angular velocity $\omega = \mathrm{SP(A)} = 1$. In this case, we can present equation (207) as follows:

$$\Delta p \Delta x = \hbar = \mathrm{SP(A)} = 1 \tag{207a}$$

Alternatively, we can assign the above equation any number or probability value without changing its validity. If we consider Schrödinger wave equation, which gives an asymmetrical solution for the electron (fermion, hemisphere), while photons are presented as symmetrical harmonic waves, we may choose to consider this result in (207a):

$$\Delta p \Delta x = \mathrm{SP(A)} \geq \frac{1}{2}\hbar = \frac{1}{2} \times 1 = \frac{1}{2} \tag{208}$$

Equation (208) is another frequent mathematical presentation of Heisenberg uncertainty principle. Theoretically, we can assign the action potential of the particle any other number, or express it with different quantities, e.g. energy and conventional time. As a result we obtain another frequent mathematical presentation of Heisenberg uncertainty principle:

$$\Delta t \Delta E = \mathrm{SP(A)}[2d - space]f = E_A \geq \frac{1}{2}\hbar \qquad (208a)$$

In this context, it is of historical interest to observe that Heisenberg has independently developed an equivalent mathematical expression of Schrödinger wave equation of quantum mechanics by employing mathematical matrices from the theory of sets. This illustrates the redundancy of physical endeavour as applied mathematics.

We are told that an important consequence of Heisenberg uncertainty principle is:

> „the existence of a minimal kinetic energy, the so called **zero point energy**, which a particle always conserves when it is enclosed in a finite space. Consider now a particle with the mass *m* that is enclosed in the one-dimensional volume of *l*. The *uncertainty* cannot be greater than *l*, hence the impulse uncertainty is $\Delta p \geq \hbar / 2l$. As the magnitude of the impulse must be at least as big as its uncertainty, the kinetic energy is at least:

$$E_{kin} = \frac{1}{2} m \mathrm{v}^2 = \frac{\hbar^2}{8ml^2} = \mathrm{SP(A)}[2d - space - time] \qquad (209)$$

> From this we should conclude that there is always a zero point energy, the magnitude of which is inversely proportional to the volume *l*.“[37]

The absurdity of these statements should be cogent to the reader. This is the stuff of modern quantum mechanics. Therefore, we shall not be surprised to establish that most physicists do not understand this discipline. It begins with the use of such terms as „uncertainty“ with a highly uncertain connotation. The explanation of this ambiguous physical terminology is historical. Today, Heisenberg uncertainty principle is presented in terms of statistics, but when it was first postulated in 1926, the theory of probability had not yet been developed. Kolmogoroff introduced the concept of probability axiomatically in 1933[38]. Subsequently, the term „uncer-

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[37] From PA Tipler, p. 1231-1232 (German ed.).

[38] Grundbegriffe der Wahrscheinlichkeitsrechnung, Springer, Berlin, 1933.

tainty“ has been used in the same connotation as the term „probability“. We have shown that any probability value has the real magnitude of space or time. In this sense, the above statement „the uncertainty cannot be greater than *l*“ becomes clear. The same holds for the statement that „the magnitude of the zero point energy of the particle is inversely proportional to its volume“ - it is an intuitive perception of the reciprocity of energy and space.

Thus Heisenberg uncertainty principle can claim the status of a principle - its principal flaw is, however, that it is an incomplete, partial perception of the nature of space-time and therefore of little cognitive value.

5.4 SELECTED SOLUTIONS OF QUANTUM MECHANICS IN THE LIGHT OF THE UNIVERSAL LAW - HOW TO CALCULATE THE MASS OF NEUTRINOS?

As physics cannot explain the quantity mass, it has produced a collection of paradoxical statements which will merit the attention of future scientists as valuable documents on the intellectual confusion of this empirical discipline during the twentieth century. One of them is the dispute over whether **neutrinos** have a rest mass or not. This has led to some expensive experiments[39]. In addition, it is generally believed that the destiny of the standard model of modern cosmology is closely linked to this question: the existence of neutrinos with rest mass would inevitably lead to the rejection of this model. We refute the standard model on the basis of the Law. This example anticipates the results of the new cosmology (see section 7.).

Today, it is generally believed that there are six different kinds of neutrinos: the electron neutrino ν_e, the myon-neutrino ν_μ, and the tauon-neutrino ν_τ, and their corresponding antiparticles. The simplest beta decay associated with the occurrence of neutrinos is the decay of an unstable neutron in a proton and an electron:

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[39] Recently, it has been confirmed that neutrinos have a mass. This result is a tautology of the Law - as all systems of space-time have energy, we can build energy relationships, that is, mass, for every system within mathematics and do not need to perform expensive experiments to confirm this in the real world.

$$n \rightarrow p + e^{-} + anti\text{-}\nu_e \tag{210}$$

During this nucleus decay a **surplus energy E_s = 0.782 MeV** is observed. This energy is attributed to the electron-antineutrino(s). Normally, it would be sufficient to know the magnitude of this energy to determine the mass of the antineutrino. The problem is that this decay exhibits a continuous distribution of the kinetic energy of the emitted beta-particles (kinetic electrons) from nearly zero to the maximal available energy. For this reason, it is only possible to postulate an upper limit of the energy of the antineutrinos. As these particles do not enter into energy interactions with other particles of matter, there is no possibility of determining their energy and mass in a direct way. These quantities can now be easily calculated from the known data of this beta decay by considering the mass m_p of the basic photon. We shall only present the general approach and leave the tedious calculation to professional physicists.

The energy distribution of beta rays can be presented as a curve that can be regarded as an aggregated action potential (U-set) of the underlying beta particles, which exhibit continuous, but discrete kinetic energies. We can determine the area under the curve (area integral) and present this quantity in terms of the aggregated charge (area) of the kinetic electrons. Alternatively, the curve can be described in terms of statistics. It builds a peak that represents the maximum level of the emitted beta energy, that is, the maximum number of emitted electrons (electrons with the most frequent energy E_i). When this energy is compared to the maximal kinetic energy E_m of the emitted electrons, its magnitude is about one third of the latter: $E_i = E_m/3$. Observe the same relationship $R = C_m/3$ between the universal gas constant R in (72) and the molar heat capacity C_m of metals in (78) - both quantities are defined as thermodynamic energy. The maximal energy of beta rays is given in special tables for each decay. Thus we can easily calculate the total distribution energy of beta rays $\sum E_e$ of any nucleus decay from known data, for instance as AUC. This total energy can be expressed by UE as a function of the mass of the basic photon:

$$\sum E_e = \sum m_e c^2 = m_p c^2 \sum f_e \tag{211}$$

The aggregated time of the beta rays $\sum f_e$ is given in comparison to the time of the electron at rest $f_e = f_{c,e} = 1$. If we depart from the neutron decay in (210), we obtain for the **energy** and **mass** of the **electron-**

antineutrinos the following simple equations:

$$E_{anti-\nu} = E_n - \left(E_{pr} + \sum E_e\right) \tag{212}$$

$$m_{anti-\nu} = m_p\left(f_{c,n} - f_{c,pr} - \sum f_e\right) \tag{213}$$

The only unknown variable in both equations is the sum (integral) of the frequency distribution Σf_e of the emitted beta particles. This quantity gives the relativistic increase in the energy of the electrons during beta decay in comparison to their rest energy. When such calculations are performed, it may transpire that the antineutrinos exhibit a similar curve of continuous energy distribution as observed for beta rays.

In order to prove the validity of the above equations, we shall use the above equations to calculate the **surplus energy E_s** and its **mass (energy relationship) m_s** from neutron beta decay. In this case, we have to only substitute the aggregated time of the beta rays $\sum f_e$ with the Compton frequency of the electrons, which is the **intrinsic time** of this particle at rest (5.1):

$$m_s = m_p(f_{c,n} - f_{c,pr} - f_{c,e}) =$$

$$= 0.737 \times 10^{-50}\ \text{kg} \times 1.8934 \times 10^{20} = 1.395 \times 10^{-30}\ \text{kg} \tag{214}$$

$$E_s = m_s c^2 = 1.395 \times 10^{-30}\ \text{kg} \times 8.987 \times 10^{16}\ \text{m}^2\text{s}^{-2} =$$

$$= 1.253 \times 10^{-13}\ \text{joule} = 0{,}782\ \text{MeV} \tag{215}$$

We obtain exactly the surplus energy of the neutron decay (210). As we see, the only practical problem in the calculation of the neutrinos' mass is to determine exactly the total energy of the beta rays in any nucleus decay involving neutrinos. This should not be a major problem to modern experimental physics, which is applied mathematics. This is another prospective test for the validity of the new axiomatics and a proof for the obsolescence of fundamental experimental research.

6. SPACE-TIME CONCEPT OF PHYSICS

6.1 CLASSICAL MECHANICS

Like mathematics, physics has failed to define the primary concept of space-time in terms of knowledge. This principal flaw has been carried on in all subsequent ideas which this discipline has developed so far. The method of definition of space-time in physics is geometry. It begins with the Euclidean space of classical mechanics. The substitution of real space-time with this abstract geometric space necessitated the introduction of two *a priori* assumptions on space and time by Newton in his Principles of Mathematics[40] that have not been seriously challenged since. Otherwise, we would not witness the parallel existence of classical mechanics and the theory of relativity. If Einstein's theory of relativity were a full revision of Newtonian mechanics, the latter would no longer exist. In the new axiomatics, we integrate all particular disciplines of physics into one consistent system and thus eliminate them as separate areas of scientific knowledge.

Euclidean space is the abstract reference system to which all other physical events are compared by the method of geometry according to PCA. It is the primary inertial reference frame of all reference frames, in which Newton's law of inertia (1st law) holds true. This law is an abstract tautological statement within geometry and cannot be applied to any real reference system. The reason for this is that Euclidean space has nothing to do with real space-time. Classical mechanics contains no knowledge of the properties of space-time, as they are defined at the beginning of our axiomatics. According to Newton, space-time is absolute, empty, inertial, that is, free of forces, and can be expressed in terms of straight lines. These properties are summarized in the law of inertia postulating immobility (rest), or a straightforward motion (translation) with

[40] I. Newton, Philosophiae Naturalis Principia Mathematica; translated from Latin by A. Motte, London, 1729.

uniform velocity ($a = 0$) for all objects, on which no force is exerted. This law remains in apparent contradiction to the second and third law, and the law of gravity describing gravitation as the origin of acceleration. While the 1st law is a mathematical fiction, the other laws of classical mechanics assess reality: there is no place in real space-time (universe) where no gravitational (or other) forces are exerted - we always observe rotations (Kepler's laws). As any rotation has an acceleration of $a > 0$, the law of inertia is not valid for rotations. This paradox of classical mechanics justifies Born's estimation of Newton's cardinal failure: „Here we have clearly a case in which the ideas of unanalysed consciousness are applied without reflection to the objective world."[41] Since then, this remark can claim ubiquitous validity for all physicists. From this analysis of the space-time concept of classical mechanics, we can conclude:

1. The introduction of Euclidean space for real space-time by Newton is the primary epistemological flaw of classical mechanics. The properties of this geometric space are: a) emptiness (no forces, no acceleration); b) homogeneity; c) the existence of straight paths (lines) d) absoluteness of space and time - no change of space and time magnitudes (immobility).

2. These properties of Euclidean space are embodied in the law of inertia, which is an erroneous abstract idea without any real physical correlate. This law builds a basic antinomy with the other laws of mechanics, which assess real forces, accelerations, and rotations.

3. While the absoluteness of space and time in classical mechanics is rejected by the theory of relativity, the homogeneity of space-time, which is tacitly accepted by the same theory, is refuted by quantum mechanics.

4. However, these disciplines make no effort to define the properties of the primary term of space-time in terms of knowledge. For this reason, classical mechanics still exists as a separate discipline, although the basic antinomy appears in a disguised form in the initial-value problem (deterministic approach of classical mechanics) versus Heisenberg uncertainty principle (intuitive notion of the transcendence of space-time).

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[41] M. Born. Einstein's theory of relativity, Dover Publ. New York, 1965, p. 57-58.

6.2 THE CONCEPT OF RELATIVITY IN ELECTROMAGNETISM

The partial correction and further development of Newtonian mechanics was done by Einstein - first, in the **special theory of relativity** and then in the **general theory of relativity**. The latter is the basis of modern cosmology. However, the origins of the theory of relativity were laid in electromagnetism and this concept is meaningless from an epistemological point of view without considering the concept of **ether**. The main achievements in electromagnetism (Maxwell, Lorentz) stem from the firm belief that ether exists and is another form of substance, which fills empty Euclidean space, that is, it should substitute empty space. The further development of the ether concept, leading to its refutation, has furnished the two basic ideas of the theory of relativity: 1) Light has a constant finite velocity for all observers; 2) The ether, which has been regarded as an invisible elastic matter, substance, or continuum, where light is propagated, cannot fulfil the expectations attributed to the absolute, static Euclidean space of mechanics. Because of this, there is no possibility of proving the **principle of simultaneity** that has been considered valid in classical mechanics. Instead, it has been found that all phenomena appear to be **relative** for any observer with respect to space and time. It was Einstein's stroke of genius to realize the full importance of this simple fact. Before we proceed with Einstein's theory of relativity and explain why he failed to discover the „universal field equation", we must first discuss the precursors of the concept of relativity in electromagnetism.

From a cognitive point of view, electromagnetism has always been a **dualistic** theory. At the time when Huygens established the electromagnetic wave theory, Newton already supported the concept of particles. The dispute between these two opposite views was very stimulating and triggered the first measurements of the speed of light. As early as 1676, Römer was able to measure the speed of light from astronomic observations with an astounding degree of precision (c = 299793 km/s). In 1727 Bradley discovered another effect of the finite speed of light, namely, that all fixed stars perform an annual rotation due to the revolution of the earth around the sun. Since Foucault (1865), we know that the speed of light in air is greater than its speed in any other medium. This is the first confirmation of the maximal finite speed of light in empty space.

The major objective of electromagnetism, which evolved in the meantime into a separate discipline beside classical mechanics, was to find an

explanation for the propagation of light in empty space as introduced by Newton in mechanics. If light were a transversal wave, as most experiments indicated, then it could only be propagated in an elastic medium, as the theory of optics preached at that time (Fresnel). These considerations led to the development of the **ether concept**.

This concept is of central theoretical importance, for it is a synonym for the primary term. We have shown in 1.2 that the General continuum law is the differential form of the Law in an elastic medium, from which the classical wave equation (2.5), Maxwell's four equations of electromagnetism (4.13), and Schrödinger wave equation of quantum mechanics (5.2) have been derived within mathematics. The ether concept was the most elaborate intuitive perception of the primary term. Its refutation on the basis of the **Michelson-Morley experiment** was a consequence of the failure of the ether concept to exclude all false properties attributed to the primary term since the introduction of Euclidean space in classical mechanics.

The Michelson-Morley experiment embodied the vicious circle of empirical agnosticism, to which physics had been subjected before the Law was discovered. The projection of the properties of Euclidean space to ether led to the following cognitive outlook of electromagnetism: ether was a real absolute reference system of material character analogous with absolute, abstract Euclidean space as introduced by Newton. Therefore, ether was defined as a static, that is, **immovable** (Newton) elastic medium that filled the empty space of mechanics. In this medium, light was propagated with the speed of c. All other motions could be set in relation to this real immovable reference system of absolute character. The objective of the ether hypothesis was not only to provide a logical explanation for electromagnetism from a cognitive point of view, but also to eliminate the empty Euclidean space. The aim of the Michelson-Morley experiment was to prove this hypothesis. Before we discuss its results, we shall explain why this hypothesis, which was on the right track, must be refuted from a theoretical point of view.

The ether concept incorporates the dualistic view in optics and classical mechanics, whereby medium and waves are considered as two distinct entities (N-sets). This is the classical epistemological flaw one regularly meets in conventional physics. For the first time in the new axiomatics, all real systems and levels of space-time are regarded as U-subsets that contain themselves as an element. They can only be distinguished in the mind by means of mathematics, but not in real terms.

When we apply this fundamental axiomatic knowledge to ether, we must conclude that there is no possibility of distinguishing between motion as wave and medium. We have seen that the wave equation is derived by considering the rotation of the particles in the static medium. In the new axiomatics, motion is a synonym for the primary term - the (elastic) continuum (PLE). The definition of its basic quantity, velocity, is axiomatically derived from it as one-dimensional space-time within mathematics. Therefore, we can write the following equivalence with respect to ether:

$$\textit{ether as medium} = \textit{continuum} = \textit{photon space-time} =$$

$$= c = c^2 = LRC = c^n = cons. = 1 \tag{216}$$

This equation simplifies our understanding of the concept of ether and relativity to an extraordinary extent. It says that [1*d-space-time*] is constant for each level of space-time - the constant speed of light is a specific quantity of the constant photon space-time. However, constant space-time is in incessant motion - constancy of space-time and its motion do not exclude each other, but are equivalent complimentary aspects of the primary term. Bearing this in mind, it is easy to understand why the result of the Michelson-Morley experiment has led to the refutation of the ether concept, embodying the cognitive flaws of Newtonian mechanics, and at the same time confirms the nature of space-time as defined in the new axiomatics.

The ether hypothesis tested by this experiment can be summarized as follows: if the ether were a real, immovable system of reference, the measurement of the speed of light in a moving (rotating) system, such as the earth, would give different magnitudes for *c*, depending on whether the light is moving with the earth's rotation or in the opposite direction. However, neither Michelson nor Morley could find any change of *c* with respect to the earth's rotation. This correct result on the constancy of space-time, as manifested by the velocity *c* of the photon level, has led to the wrong conclusion that the earth is „immovable with respect to ether". However, the earth itself is a rotating system - it revolves around its axis, around the sun, and so on (superimposed rotation). Therefore, this gravitational system cannot be immovable in absolute terms. As *c* remains constant, the same must hold for the ether. It cannot be an immovable entity - an absolute reference system at rest, as expected in terms of Euclidean space. However, instead of rejecting the empty space of clas-

sical mechanics and modifying the ether concept, the consequence of the Michelson-Morley experiment was the **refutation of ether**, that is, of **photon space-time,** as a real system and its substitution with the concept of the void (vacuum), where actions at a distance are observed. This marks one of the darkest periods of modern physics, pushing this discipline in entirely the wrong direction for almost a century, until the Universal Law was finally discovered.

The interpretation of the Michelson-Morley experiment led to the development of the special theory of relativity. The rejection of ether has cemented the dogma that space-time is empty and homogeneous, where photons, being particles with the energy $E = hf$, propagate with the speed of light. The dogma that particles move in vacuum is based on the assumption that N-sets exist and is thus a chief epistemological flaw in physics. Departing from the nature of space-time, we exclude all concepts of science which are N-sets. In this way we eliminate all paradoxes of science and mathematics that culminate in the **continuum hypothesis.** The latter embodies the fundamental crisis of mathematics and all mathematically orientated disciplines, such as physics.

The origins of the theory of relativity were laid in electromagnetism, when it became obvious that space and time were two canonically conjugated constituents of space-time that behave reciprocally. This reciprocity is an aspect of the constancy of space-time as manifested by the parts: as $[space\text{-}time] = cons. = 1$, then $[space] = 1/[time] = 1/f$. This follows from the primary axiom. The actual reciprocity of space and time is vested in the observation that the quotient of electron area (charge) and mass $e/m_e = SP(A)_e/SP(A)_m = 0 \leq SP(A) \leq 1$ is decreasing with growing velocity $v = [1d\text{-}space\text{-}time\ ] = E$. Within the new axiomatics, this phenomenon can be immediately solved. As mass is a space-time relationship built in an abstract way when the energy (space-time) of a system, such as the electron, increases relativistically, its space-time relationship, that is, mass, will also increase with respect to the constant reference unit of 1 *kg*. At the same time its space will decrease because it behaves reciprocally to space-time.

This phenomenon is interpreted somewhat clumsily by Lorentz, who postulates that the spherical form of the electron flattens in the direction of its movement, so that the mass increases in terms of density. He considers FitzGerald's interpretation of the Michelson-Morley experiment - it suggests that the earth contracts in the direction of its revolution. This would explain why Michelson and Morley have not found any differ-

ence in *c* depending on the earth's motion. In this experiment the location of the observer is linked to the earth, or rather, he is part of the earth. For this reason the observer is not in a position to determine the relative contraction of the earth. If the observer were placed outside the earth, that is, in photon space-time, he would measure a relative contraction of the earth in the direction of rotation. FitzGerald proposes a **simple factor of proportionality,** with which this **length contraction** can be calculated:

$$\gamma^{-1} = \sqrt{1-\frac{v^2}{c^2}} = \sqrt{\frac{c^2-v^2}{c^2}} = \sqrt{\frac{dLRC}{LRC_p}} = \sqrt{\frac{\mathrm{SP(A)}_{relative}}{\mathrm{SP(A)}_{reference}}} =$$

$$= \frac{[1d-space-time]_{rel}}{[1d-space-time]_{ref}} = 0 \leq \mathrm{SP(A)} \leq 1 \qquad (217)$$

We call this factor the „**proportionality factor of Lorentz transformations**", or simply the **Lorentz factor,** because it is basic to his relativistic presentation of space and time in electromagnetism. Equation (217) shows that:

> The reciprocal **Lorentz factor** is an iterative mathematical presentation of **Kolmogoroff's probability set** as defined according to PCA within mathematics. The initial system of reference is photon space-time as expressed by the $LRC = c^2$, to which the relativistic change of space-time of the systems *dLRC* is set in relation.

Lorentz derives this factor from **FitzGerald's length contraction** and applies it to **time dilution**. He is the first to speak of the „local time" and „local space" of objects that change relativistically in the direction of movement. In terms of the ether hypothesis, FitzGerald's length contraction and Lorentz' time dilution indicate that when space and time are measured in moving objects, they will have different magnitudes compared to those measured in relation to absolute immovable ether, that is, to the space-time magnitudes measured in relation to themselves from a static point of view (building of the certain event within mathematics). In this way the relativity of space and time, which is

objectively observed and assessed by the Lorentz factor, has given birth to the theory of relativity.

In this process, both the absolute unchangeable space in classical mechanics and the concept of ether in electromagnetism have been abolished. They have been substituted by a hermaphrodite concept of space-time in the theory of relativity which is generally accepted today. It combines the emptiness and homogeneity of Euclidean space as vacuum (void) with the reciprocal behaviour of its constituents as assessed by the Lorentz factor in the electromagnetic theory of relativity. Furthermore, the general theory of relativity postulates that this space-time is „bent“ (curved) by gravitation. There is, however, no explanation as to how this energy interaction is mediated in the void or by the void because neither classical mechanics, nor Einstein's general theory of relativity, proposes any theory of gravitation. This fact demonstrates the provisional character of Einstein's theory of relativity.

6.3 THE SPACE-TIME CONCEPT OF THE SPECIAL AND GENERAL THEORY OF RELATIVITY

In 1905, Einstein realized that Lorentz transformations were not artificial presentations of the local space and time of electromagnetic systems, but were fundamentally linked to our very understanding of space-time. While the **principle of relativity** as expressed by the Lorentz factor is still believed to be of purely theoretical character, the constant speed of light is a well established fact. In the first step, Einstein refuted the **principle of simultaneity** inherited from classical mechanics and substituted it with the **principle of relative simultaneity**. This „new“ insight was a delayed discovery. Since Galilei, it took more than three centuries to realize this simple fact, although the relativity of space (position) and time has been a central theme of philosophy since antiquity. The principle of relativity is a consequence of the properties of space-time. As space-time is closed, we can arbitrarily select any system as a system of reference and compare any other system to it (PCA). This means that there is no absolute space and time, but only specific magnitudes (relationships) of the two constituents for each system and level. This is a consequence of the inhomogeneity (discreteness) of space-time. The principle of simultaneity reflects the open character of the sys-

tems of space-time as U-sets - any local interaction is part of the total energy exchange in the universe (= primary term). The principle of simultaneity is an intuitive notion that space-time is a unity. Therefore, it is not a coincidence that when Einstein discovered this principle in physics, all avant-garde movements in Europe were discovering the principle of „**simultanéité**“ in arts and poetry. Today, we speak of globalisation and regard the earth as a village. Tomorrow, if we survive, we shall develop the same attitude towards the universe.

As we see, Einstein's principle of relative simultaneity on which his special theory of relativity is based is an intuitive notion of the primary term. The two postulates of this theory are well known. The first one is the principle of relativity which says that there is no preferential inertial reference frame: natural law(s) is (are) the same in all inertial systems. The second postulate concerns the constant speed of light. The speed of light in vacuum is constant in any inertial reference frame and does not depend on the movement of the object, or alternatively: each observer measures the same value for the speed of light in vacuum. This is the traditional presentation of Einstein's postulates, which we can find in numerous textbooks on physics and the theory of relativity.

It is, indeed, amazing that until now nobody has noticed the intrinsic paradox between the two postulates. The paradox emerges from the use of the concept „inertial reference frame“. This term is introduced in conjunction with the law of inertia. This law can only distinguish between a **uniform** motion ($a = 0$) and a motion with **acceleration (**$a > 0$**)**. Per definition, all inertial reference frames should move uniformly or stay at rest, otherwise the 1st law is not valid. Does this mean that the principle of relativity does not hold in accelerated systems? Obviously not, for exactly this contradiction ought to be eliminated by Einstein's second postulate. It says that the speed of light remains the same, independently of the movement of the observer. This postulate does not discriminate between a uniform motion or a motion with acceleration. From this, it is cogent that there is a fundamental paradox between the first and the second postulate of the special theory of relativity. How can we avoid this paradox?

This paradox is actually eliminated in the general theory of relativity, which is based on the **principle of equivalence**: „a homogeneous gravitational field is completely equivalent to a uniformly accelerated reference frame.“[42] This principle acknowledges the simple fact that there are

[42] PA Tipler, p. 1132.

no real inertial reference frames. For this reason, in the special theory of relativity, Einstein substitutes the concept of the inertial reference frame which is an object of thought without a physical correlate, with the real reference frame - the local gravitational potential LRC_G. For instance, the gravitation of the earth is such a real reference frame. It is equivalent to an accelerated system, for example to a rocket with the same acceleration as g, but launched in the opposite direction.

There are two major cognitive aspects of this principle that need to be elaborated. Firstly, there are infinite real reference frames because there are infinite celestial objects in space-time with specific gravitational fields or potentials (*LRC*). Secondly, this principle holds only in motions with uniform acceleration and does not consider motion with changing acceleration. In the latter case, the motion is regarded as consisting of infinite small segments of uniform acceleration. As we see, the infinity of real reference frames is basic to the principle of equivalence. It is an intuitive notion of the infinity of space-time. This is also evident from the name of this principle. The idea of equivalence reflects the PLE of our axiomatics when applied to the parts (PCA). Any definition of a mathematical equivalence is based on this principle. We come to an important conclusion:

> The **principle of equivalence** of the general theory of relativity is an application of PCA. It also consists of building equivalences and comparisons. This is the only objective of this discipline.

Evidently, when the theory of relativity is taken to its logical conclusion (which Einstein obviously failed to do), it leads to the rejection of the law of inertia. This is inevitable in the light of the new axiomatics. However, this law has a rational core that should be spelt out for the sake of objectivity. From a mathematical point of view, the 1st law is a special case (borderline case) of the 2nd law $F = ma$; if $a = 0$, then the resultant force is zero $F = 0$, and we have the condition of the 1st law. The law of inertia holds only in reference frames which are free of forces, that is, in empty space. However, there is no empty space - space-time is continuous. What is the epistemological background of this law in the light of the new axiomatics? Very simple! The Universal Law departs from the reciprocity of space and time, where space-time (energy) is proportional to time $E \approx f$. If time approaches zero $f \to 0$, then space-time will also approach zero $E \approx f \to 0$. In this case, space will approach infinity

[*space*] $\rightarrow \infty$. This infinite space will be homogeneous because its discreteness is a function of time *f*: *discreteness* = $f \rightarrow 0$. The extent of such an abstract space can be formally presented by means of straight lines (paths) within geometry because the radius of this rotation will be infinite $r \rightarrow \infty$. Under these boundary conditions, space-time will acquire the properties attributed to empty Euclidean space, as they are embodied in the law of inertia. From this we can conclude:

> The law of inertia is a mathematical abstraction (object of thought) that describes the hypothetical boundary conditions of space-time:
>
> when $E \approx f = discreteness \rightarrow 0$, then
>
> [*space*] $\rightarrow \infty$ = homogeneous, empty space =
>
> = Euclidean space (straight lines) (218)

The actual theory of relativity is an application of Lorentz transformations of electromagnetism with which the space-time of all material objects is assessed, while at the same time photon space-time is regarded as an empty, homogeneous entity. This mathematical presentation of space-time and its abstract quantities, such as mass and momentum, is called „**relativistic“**. Hence the terms: **relativistic energy**, **relativistic mass,** and **relativistic momentum**. These quantities are built within mathematics according to PCA by selecting photon space-time as the initial reference frame. When FitzGerald length contraction and Lorentz time dilution are expressed within the theory of relativity, we immediately recognize that the **Lorentz factor** is another mathematical presentation of Kolmogoroff's probability set:

$$\frac{t_R}{t} = \frac{L}{L_R} = \gamma^{-1} = \sqrt{1 - \frac{v^2}{c^2}} = 0 \leq SP(A) \leq 1 \qquad (219)$$

$$\text{when } v \rightarrow 0, \text{ then } \gamma^{-1} \rightarrow 1,$$
$$\text{when } v \rightarrow c, \text{ then } \gamma^{-1} \rightarrow 0$$

In equation (219), t_R is the rest time between two events (Note: all events

are action potentials), also called „local“ or „own time“, that is measured in a system at rest; t is the diluted time measured in an accelerated reference system. Analogously, L_R is the length of the system at rest, and L is the contracted length under acceleration. The reciprocal of the Lorentz factor γ^{-1} assesses the relativistic change of space and time, that is, of the space-time of the systems in motion. Recall that all systems are in incessant motion. This is also the basic conclusion of the theory of relativity, namely, that all objects are in relative motion. From equation (219), it becomes evident that:

the **Lorentz factor** gives the **physical probability space**:

$$\boldsymbol{\gamma^{-1} = 0 \leq SP(A) \leq 1} \tag{220}$$

This is a fundamental conclusion of the new axiomatics that rationalizes the theory of relativity to **applied statistics of space-time.** The probability set of all space-time events, being action potentials, is set in the Lorentz transformations in relation to the *LRC* of photon space-time: $LRC_p = U_U = c^2 = [2d\text{-}space\text{-}time]$. When we substitute conventional time t with time $f = 1/t$ in equations (219) and (220), we obtain UE as an RT:

$$\frac{E_1}{E_2} = \frac{f_1}{f_2} = \frac{[1d - space]_2}{[1d - space]_1} = \frac{t_R}{t} = \frac{L}{L_R} = \gamma^{-1} = \sqrt{1 - \frac{v^2}{c^2}} = \mathrm{SP(A)} \tag{221}$$

This is the whole theoretical background of Einstein’s theory of relativity - be it special or general. It is a partial and inconsistent intuitive perception of the Law within mathematics. After being revised, it is integrated into the new axiomatics. In this way we eliminate this discipline as a distinct area of physical knowledge. For this purpose we shall explain the two basic terms of the theory of relativity, rest mass, and relativistic mass, in terms of the new axiomatics, as their wrong conventional interpretation is the main source of the cognitive malaise which afflicts physics today.

6.4 REST MASS IS A SYNONYM FOR THE CERTAIN EVENT, RELATIVISTIC MASS IS A SYNONYM FOR KOLMOGOROFF'S PROBABILITY SET

By proving that mass is an energy relationship, we have shown that Einstein's equation postulating the equivalence between energy and mass is a tautological statement. This equivalence plays a central role in the theory of relativity and in physics today. While in classical mechanics mass is defined in a vicious circle as the property of the gravitational objects to resist acceleration, in the theory of relativity this quantity is regarded as being equivalent to matter, while the term energy is restricted to photon space-time. This is the epistemological background of Einstein's equation $E = mc^2$ or $m = E/c^2 = E_x/LRC_p$. According to PCA, the energy of any object of matter E_x is compared to the energy of the reference system, in this case, to the level of photon space-time, and is given as an energy relationship m. This relationship can be regarded statically or with respect to the own motion of the object. In the first case, this quantity is defined as **rest mass** m_0, in the second case, as **relativistic mass** m_r. Within the theory of relativity, the two quantities are expressed by Lorentz transformations:

$$E = E_{kin} + m_0c^2 = \frac{m_0c^2}{\sqrt{1-\frac{v^2}{c^2}}} = \gamma m_0c^2 = m_rc^2 \tag{222}$$

This is the equation of the **total relativistic energy *E*,** which is given as the sum of the kinetic energy E_{kin} and the rest energy $E_0 = m_0c^2$. We use this equation because it includes the relationship between the **relativistic mass** and the **rest mass** $m_r = \gamma m_0$. Equation (222) is the relativistic expression of Einstein's equation $E = mc^2$. It reveals that the quotient of rest mass m_0 and relativistic mass m_r is another pleonastic presentation of the **physical probability set** within mathematics:

$$m_0/m_r = \gamma^{-1} = 0 \leq SP(A) \leq 1 \tag{223}$$

We discover PCA again - the theory of relativity can only define the quantity „relativistic mass of an object" in relation to „the mass of the

same object at rest“. Both quantities are abstract subsets of space-time that are built within mathematics. So is their quotient, the Lorentz factor - it represents the continuum, respectively, the probability set. When we compare the **rest mass** with itself, we obtain the **certain event**:

$$m_0/m_0 = m_0 = \mathrm{SP(A)} = 1 \tag{224}$$

> **Rest mass** and **relativistic mass** are abstract quantities of space-time (space-time relationships) that are built within mathematical formalism. Rest mass is the abstract intrinsic reference system of the observed relativistic mass (PCA). It symbolizes the certain event $m_0 = 1$. The relativistic mass gives the real space-time of any system in motion. As all systems are in motion, we can only observe relativistic masses. The relativistic mass is defined in relation to rest mass (PCA). As mass is a space-time relationship, any relativistic mass of a system is greater than its rest mass $m_r > m_0$. Their quotient represents the **physical probability set**: $m_{0/}m_r = 0 \leq \mathrm{SP(A)} \leq 1$.

This equation is derived by PCA and includes the entire cognitive background contained within the two basic terms of the theory of relativity, rest mass and relativistic mass, that has not been realized either by Einstein or by any other physicist after him. The theory of relativity could, indeed, be very simple once the right axiomatic approach is employed - the new axiomatics of the Universal Law.

7. COSMOLOGY

7.1 INTRODUCTION

While physics has evolved to become a study of particular levels and systems of space-time that are closely associated with human demands, one would expect that cosmology has been developed into a study of the primary term when PLE is considered. This is, however, not the case when one analyses the few acceptable textbooks on this discipline. The outstanding feature of modern cosmology is the lack of a clear-cut definition of its object of study - the universe, space-time, energy, or cosmos is described in a vicious circle in the same mechanistic and deterministic manner as are its systems and levels in physics. Similarly, cosmology has failed to develop an epistemological approach to space-time. Nevertheless, there is a subconscious pattern behind all cosmological concepts that constitutes an intuitive perception of the primary term. This is a consequence of the fact that human consciousness abides by the Law. The objective of this short survey on modern cosmology is to reveal this aspect. As we cannot consider all heterogeneous schools and ideas of this discipline, we shall restrict ourselves to the **standard model**, which represents the mainstream of cosmological thinking today. Based on the Law, we shall reject this model and debunk the present system of cosmology. The remaining mathematical facts will be integrated into the new axiomatics.

Modern cosmology is a new discipline. It began in the twenties when the general theory of relativity was being developed as a geometric study of empty space-time and applied to the universe as an ordered whole (Einstein, Lemaître, de Sitter, Friedmann, etc.). Its core is the standard model, a collection of heterogeneous ideas which has been put together in a similar manner to that in the standard model of physics. Hence the same name as first suggested by Weinberg (1972). The standard model of cosmology is a **hot expanding world model** based on the following primary ideas:

1. The universe is **homogeneous** and **isotropic** on average, at any place, and at any time. This is called the „**cosmological principle**". This philosophical concept is basic to any cosmological approach. It is an application of PLE - the primary term is perceived in the same way by anybody, at any time, at any place. This allows the establishment of an objective axiomatics that leads to the unification of science, which is a metaphysical level of space-time. This is essentially an anthropocentric definition, because for obvious reasons we have no idea of how other conscious beings (aliens) perceive the physical world. The cosmological principle, being a rudimentary idea of the primary term, was first introduced by Milne (1935) and then further developed by Einstein as a variation of his principle of equivalence.

Einstein departs from the **Mach principle.** It postulates that the inertial reference frames adopted from classical mechanics should be regarded in relation to the distribution and motion of cosmic mass, that is, in relation to the actual space-time relationships[43]. Einstein generalizes the Mach principle and applies it to the whole universe. This is an arbitrary decision (degree of mathematical freedom), since the local space-time relationships which we observe are heterogeneous and discrete. Indeed, the universe consists of clusters of galaxies separated by photon space-time which is empty of matter, as is confirmed by recent astronomic evaluations, for instance, by the Hubble telescope. Therefore, the cosmological principle, which postulates a homogeneous and isotropic universe, does not assess the real properties of space-time, but is an abstract equivalence that is built within mathematical formalism. This fact reveals the absurdity of Einstein's endeavour to exclude human consciousness from any scientific perception of the physical world. He must have been firmly convinced that natural laws exist independently of human consciousness.

2. The universe expands according to **Hubble's law** with the **escape velocity** v of the galaxies, which is proportional to the distance *dl* of the observer from the galaxies:

$$d\mathsf{v} = dl/dt = H_0 l = [1d\text{-}space\text{-}time] \qquad (225),$$

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[43] "Einstein adopted, as Mach's principle, the idea that inertial frames of reference are determined by the distribution and motion of the matter in the universe". P.J.E. Peeble, Principles of Physical Cosmology, Princeton University Press, New Jersey, 1993, p. 11.

Hubble's law is an application of the Law for one-dimensional space-time. H_0 is called the **Hubble constant**. It is reciprocal conventional time and thus a constant quantity of time $H_0 = f$. The epistemological background of this constant is not known in cosmology. We shall prove that this specific magnitude gives the constant time of the visible universe $H_0 = f_{vis}$. In astrophysics, the Hubble constant is roughly estimated from the intensity of selected galaxies. Its value varies from author to author from 50 km/s to 80 km/s per Mpc (*Megaparsec*). Latest estimations tend towards the smaller value. The reciprocal of the Hubble constant $1/H_0$ is called „**Hubble time**" and is thus an actual quantity of conventional time. It is regarded as the upper limit of the **age of the universe** $A_U \leq 1/H_0$ when the gravitational forces between the galaxies are ignored. As the traditional cosmological units of space and time are highly confusing, we shall convert them into SI units. This will significantly simplify our further discussion. The cosmological unit of distance [1*d-space*] is 1 Megaparsec (1 Mpc) = 3.086×10^{22} m. When we use the SI unit 1 m, we obtain for **Hubble time** (= **age of the universe**) the following conventionally estimated value:

$$A_U = 1/H_0 = 3.086 \times 10^{22} \text{ m} / 5 \times 10^4 \text{ ms}^{-1} = 6.17 \times 10^{17} \text{ s} \quad (226)$$

This corresponds to an estimated age of the universe in the order of 20 billion years. According to the standard model, the present universe has a „finite" age that is determined by the big bang, which is defined as a space-time singularity. This assumption is in apparent contradiction with the primary axiom which says that the universe, that is, its space and time is infinite. At present, the actual age of the „finite universe" is estimated to be about 10-15 billion years when the gravitational forces between the galaxies are theoretically considered. However, as the mass of these galaxies cannot be determined - more than 90% of the estimated mass of the universe is defined as „**dark matter**", which simply means that scientists do not know anything about it (see neutrinos' mass above) - these estimations are of highly speculative character. It is important to observe that all basic space and time magnitudes in cosmology, such as the Hubble constant, can only be roughly estimated. This shows that present cosmology is anything but an exact empirical science. As these quantities are basic to the standard model, fundamental paradoxes have emerged, depending on the values employed (see the mother-child paradox below). This is already

a strong indication that the standard model is not validated at all.

From A_U one can easily obtain the **radius of the finite universe** R_U as postulated in the standard model. By Hubble's law, the actual magnitude of the constituent of the universe is defined as the maximal distance that can be observed, that is, the maximal distance which the light that is emitted from the remotest galaxies covers before it reaches the observer:

$$R_U = cA_U = 2.9979 \times 10^8 \text{ ms}^{-1} \times 6.17 \times 10^{17} \text{ s} =$$

$$= 1.85 \times 10^{26} \text{ m} \tag{227}$$

According to Hubble's law, both values are **natural constants**. While this fact confirms the constancy of space-time as manifested by its systems - in this case, by the visible universe - it is in apparent contradiction with the assumption that the universe „expands". Modern cosmology does not give any explanation of this obvious paradox between Hubble's law and the hypothesis of the expanding universe as embodied in the standard model. This is the main deficiency of this discipline, as the standard model is based on Hubble's law. A major objective of this section is to prove that:

> The two magnitudes, R_U and $H_0 = 1/A_U$, are **universal cosmological constants** that assess the constant space-time of the **visible universe**. When modern cosmology speaks of the „universe", it means the space-time of the visible universe, which is a system (U-subset) of space-time. The visible universe is not identical with the primary term of space-time (energy, universe, etc.). The primary term cannot be assessed in a quantitative way, but only in philosophical and metamathematical categories.

Thus the visible universe is a specific, concrete cosmological system of space-time. Like any other system, it has a constant space-time - it is a U-set that manifests the properties of the whole. Therefore, its space (R_U) and time $A_U = 1/H_0$) magnitudes are natural constants. As space-time is an open entity, we shall prove that these constants can be precisely calculated from known space-time constants, which can be exactly measured in local experiments. In this way we shall eliminate the necessity of performing expensive research of doubtful quality in astrophysics. While

proving that modern cosmology can only assess the constant visible universe, we shall refute the erroneous hypothesis of an expanding universe from an infinitely small space of incredible mass density, called the „big bang“. This state is believed to have existed about 15-20 billion years ago.

3. The standard model describes the past and present expansion of the universe. It is based on Hubble's law and the existence of the **cosmic background radiation** (CBR). The latter is regarded as a remnant of the initial, extremely hot radiation of the big bang that has been adiabatically cooled down to the present temperature of 2.73 K. The theoretical basis of this hypothetical model is the theory of relativity, which is geometry applied to the visible universe and deals essentially with the level of gravitation (see Einstein's cosmological constant below). Therefore, the method of definition and measurement in cosmology is mainly the geometry (topology) of space. In addition, the statistical method is used. The standard model is highly limited and forbids questions like: „Where does the universe expand? Where does the space which opens between the expanding galaxies come from?“, and so on. In other words, this model evades any questions that concern a true knowledge of the universe.

The standard model cannot explain many basic facts that have been accumulated in the last few years. For instance, new measurements by the COBE satellite have confirmed that the CBR is not isotropic and homogeneous as postulated by the standard model, but exhibits a **local anisotropy**. These conflicting facts have necessitated further modifications of the standard model. The so-called „inflation hypothesis“ has been developed by Guth and Linde to overcome the problem of CBR-anisotropy, which is of major theoretical importance. However, this hypothesis is of such speculative character that it cannot be verified by any means. It rather exposes cosmology as science fiction. For this reason the inflation hypothesis is not considered part of the standard model, but a complimentary conceptual contribution of provisional character. The standard model excludes alternative cosmological explanations, such as the **steady-state models** of Bondi (1960) or Dicke (1970). These models reflect more adequately the constant character of space-time. As these models do not represent the mainstream of cosmological dogma, they will not be discussed in this short survey on cosmology.

7.2 HUBBLE'S LAW IS AN APPLICATION OF THE UNIVERSAL LAW FOR THE VISIBLE UNIVERSE

Equation (225) shows that **Hubble's law** is an application of the new axiomatic definition of one-dimensional space-time. As the Hubble constant is a natural constant, the law assesses the constant space-time of the visible universe $dv = dl/dt = H_0 l_{max} = [1d\text{-}space\text{-}time] = cons.$ The proof is fairly simple. According to Hubble's law, the maximal escape velocity dv which a galaxy reaches before it emits a light signal to the observer is the speed of light $dv \rightarrow c$. As Hubble's law claims universal validity, it also holds for escape velocities that are greater than c. In this case, the light emitted by galaxies with $dv > c$ will not reach the observer because the speed of light is smaller than their opposite escape velocity. The resultant speed of the emitted photons is negative with respect to the observer. As our information on any material celestial object in the universe is transmitted through photon space-time, galaxies with a higher relative escape velocity than the speed of light are no longer visible to the local observer. This means that there is an **event horizon**, beyond which Hubble's law still holds true, but can no longer be observed. The validity of Hubble's law beyond the event horizon also follows from the fact that it is an application of the Law of space-time, while the visible universe is a particular system thereof.

The event horizon determines the boundary of the visible universe with respect to human beings. The boundaries of the visible universe are determined by the magnitude of c because photon space-time is the ultimate level of space-time which we can perceive at present. As all levels of space-time are U-subsets and contain themselves as an element, we cannot exclude the possibility that there are further levels beyond photon space-time with a higher velocity than c. If we gain access to them, we shall enlarge our event horizon of the visible universe. As we see, the event horizon assesses the space of the visible universe with respect to our senses and present level of technological development. It can be expressed as $[1d\text{-}space]$-quantity, for instance as radius R_U (open straight line), circumference S_U (closed line), or $K_s = \mathrm{SP(A)}[2d\text{-}space]$ = spherical area = charge in geometry (method of definition = method of measurement). As in all other systems, these quantities are constant: they assess the constant space of the visible universe with the constant time of H_0. We conclude:

Hubble's law assesses the constant space-time of the **visible universe**:

$$d\mathsf{v} = dl/dt = H_0 l_{max} = H_0 R_U \rightarrow c = [1d\text{-}space\text{-}time]_{vis} = cons. \quad (228)$$

The maximal distance from the observer l_{max} is defined as the **radius** of the visible universe $l_{max} = R_U$ (228). In cosmology, one usually speaks of the „universe". Whenever we use this term from now on, we shall mean the „visible universe", which is a system of space-time and is thus not identical with the primary term. From the radius of the universe, we can easily obtain the **event horizon** of this basic cosmological system as K_s within geometry:

$$\textbf{Event horizon} = K_s = \mathrm{SP(A)}[2d\text{-}space] = 4\pi R_U{}^2 = cons. \quad (229)$$

This quantity is constant for any observer in space-time. This practical equivalence is an aspect of the cosmological principle. In this sense, the cosmological principle is a U-subset of PLE for the system „visible universe" - it is an application of PCA and is thus not identical with the primary axiom. This clarification is essential for the subsequent refutation of the standard model as hot expanding hypothesis.

7.3 FROM NEWTON'S LAW TO THE VISIBLE UNIVERSE (ND)

As modern cosmology is based on the general theory of relativity, it departs from gravitation to explain the geometry of the universe. The common quantities of classical mechanics, mass and density, are applied to the universe and have a central role in any conventional disquisition on cosmology. As Newton's law of gravity is considered to be of universal character, it is basic to any cosmological model, including the standard model. We have shown that this law of classical mechanics is an application of the Law for the level of gravitation. It gives the vertical energy exchange between matter and photon space-time. Photon space-time, in which all celestial bodies of matter are embedded, determines the extent (space) of the visible universe as assessed by Hubble's law. Thus the law of gravity can be applied to the visible universe or to any other subset of space-time.

In this chapter, we shall implement the novel universal equation of Newton's law of gravity $E = (c^3/G)\, f = E_{AU}\, f$ (28) and the universal action potential $E_{AU} = 4.038\times10^{35}$ kg/s of the vertical energy exchange between matter and photon space-time (30) to calculate the **mass** (space-time relationship) of the **visible universe**. For this purpose we shall use the following estimated values from the literature: radius $R_U = 1.85\times10^{26}$ m (227) and **critical density of the universe** $\rho_0 = \mathrm{SP(A)}/[1d\text{-}space] = 1\times10^{-26}$ kg/m^3 (47). The critical density is theoretically estimated from **Friedmann's model** that gives three possible solutions[44] (see below). When we apply the geometric method, we can consider the visible universe as a sphere with the **volume** V_U of:

$$V_U = \frac{4\pi R_U^{\ 3}}{3} = 26.52\times10^{78}\ \mathrm{m}^3 \tag{230}$$

The **mass** of the **visible universe** $\boldsymbol{M_U}$ is then:

$$M_U = V_U\rho_0 = 26.52\times10^{52}\ \mathrm{kg} \tag{231}$$

Alternatively, we can apply the universal equation of Newton's law of gravity (28) to calculate the mass of the visible universe. It says that in any second $f = 1$ the mass (energy) of $E_{AU} = E$ is exchanged between matter and photon space-time and vice versa. Through this energy exchange gravitation is mediated. We can set for the time of the visible universe its age $f_{vis} = A_U = 1/H_0 = 6.17\times10^{17}$ s/1 s as calculated from Hubble's law (226). In this case, we express the age as a dimensionless quotient. When we put this time magnitude in the new equation of Newton's law of gravity, we can calculate the mass (energy relationship) „created since the big bang". This calculation departs from the standard model that postulates a finite universe. We assume that in any second after the big bang the universe expands with the space-time of E_{AU}, given as energy relationship (mass) to the arbitrary SI unit of 1 kg:

$$M_U = E_{AU}\, H_0^{-1} = E_{AU}\, A_U = 4.038 \times 10^{35}\ \mathrm{kgs}^{-1} \times 6.17 \times 10^{17}\ \mathrm{s} =$$

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[44] R. & H. Sexl, Weiße Zwerge - Schwarze Löcher, chapter 9.6, p. 121-126.

$$= 24.9 \times 10^{52} \text{ kg} \tag{232}$$

We obtain for the mass of the visible universe almost the same result as calculated by the conventional geometric method (231). This confirms the transitiveness of mathematics and geometry when the Law is applied. However, equation (232) does not prove that the big bang has taken place or that the universe expands. It simply illustrates that we do not need the standard model to explain and assess the vertical energy exchange between photon space-time and matter. If we apply UE as a „law of gravity", we can calculate the mass (energy relationship) of the visible universe with respect to the experimentally observed *space* $R_U = [1d\text{-}space]$ and *time* $A_U = f_{vis}$ of this system *without knowing the critical density of the universe*.

The magnitude of this fundamental quantity, as calculated in cosmology today, is of highly speculative character, as more than 90% of the mass in the universe cannot be experimentally determined and is conveniently regarded as „*dark matter*". The density of the universe measured in astrophysics is about 10 times smaller than the theoretically calculated critical density. This is the chief shortcoming of all contemporary cosmological models, the outcome of which depends entirely on the exact calculation of the critical density of the universe. This inherent shortcoming is now eliminated in an elegant manner. Based on the knowledge that mass and density are abstract mathematical U-subsets of space-time, the problem of „dark matter" disappears as an artefact born in the cosmologist's mind (mathematics as a trap in human thinking).

The critical density is theoretically estimated in Friedmann's model (or in any other model of the universe). It allows three geometric solutions of **Friedmann's equation**, which is an application of UE (we leave the proof as an exercise for the reader), depending on the theoretically estimated critical density: 1) spherical, closed universe; 2) Euclidean, infinite universe 3) hyperbolic, infinite universe. These are abstract solutions within mathematical formalism that approximate real space-time. Friedmann's model does not specify which solution is correct. Based on the above example, we confirm that the theoretically estimated critical density of about 1×10^{-26} kg/m^3 assesses the actual space-time of the universe quite well. The result from equation (231) is almost equal to the result from equation (232). Friedmann's equation solves a spherical closed universe (1st solution) for the critical density. This result merely confirms that some early cosmologists intuitively employed the Law to esti-

mate the space-time of the visible universe from known natural constants with an astounding degree of precision, and have thus proven that space-time as a unity.

In the above calculation, we use the value of $R_U = 1.85{\times}10^{26}$ m as determined from the lowest possible magnitude of the Hubble constant $H_0 = 50$ km/s per Mpc. This constant time of the visible universe $f_{vis} = H_0$ cannot be exactly determined by the conventional method in astrophysics that is based on the measurement of the intensities of selected galaxies. This method presupposes many *a priori* assumptions and approximations that are of highly speculative character and cannot be validated by any means. This explains the broad range of H_0-values in the literature.

The inability of modern cosmology to determine the precise value of the Hubble constant is generally acknowledged as the central problem of this discipline. We shall now solve this problem conclusively. At the same time, we shall demonstrate that space-time is an entity of open subsets, so that we can depart from any magnitude of space-time which can be exactly measured in a local experiment and obtain any other cosmological constant by applying UE as an RT. For this purpose we shall depart from Newton's law of gravity. We have shown in chapter 1.7 that we can obtain a new formula of the universal gravitational constant $G = c^2/S_U$ (37) from this law, where S_U is the **circumference** of the **event horizon** of the visible universe:

$$S_U = c^2/G = [1d\text{-}space] = 13.46934 \times 10^{26} \text{ m} \tag{233}$$

From the circumference, we can obtain the **exact radius** R_U of the **visible universe** as [1*d-space*]-*quantity* within geometry:

$$R_U = \frac{S_U}{2\pi} = \frac{c^2}{2\pi G} = 2.14371{\times}10^{26} \text{ m} \tag{234}$$

As we see, the magnitude of the radius of the visible universe has been estimated fairly well in traditional cosmology when the lowest predicted value of the Hubble constant is considered (227). If we now take the exact radius of the visible universe as measured in (234), we can precisely calculate the **exact** value of the **Hubble constant** and solve the cardinal problem of modern cosmology:

$$H_0 = \frac{c}{R_U} = \frac{2\pi G}{c} = 13.984735 \times 10^{-19}\ \mathrm{s}^{-1} = 43.1568\ \text{ km/s per Mpc} \quad (235)$$

The calculated value of the Hubble constant is the most exact value that can be obtained at present within the approximate limits of the continuum of closed real numbers. This basic cosmological constant is obtained as a quotient of two other natural constants, c and G, which can be precisely measured in a local experiment. It is important to observe that the Hubble constant is a mathematical quantity defined within geometry, and has no real existence. The value in (235) is somewhat lower that the lowest estimated value for H_0 at present, but it confirms the current tendency in cosmology. The higher values which one finds for this constant in the literature are obtained when the gravitational forces are considered from a theoretical point of view. The weak point of this theoretical approach is that the gravitational forces between the galaxies are not known, as the mass of the universe cannot be determined. Such calculations are based on pure speculation and have no real value. As we have obtained the Hubble constant from UE of Newton's law of gravity, the gravitational level is already considered in our calculation (235). The space-time of the universal gravitational level is expressed by the gravitational constant G. In addition, we do not need the mass (space-time relationship) of the visible universe, although we can easily obtain it from other known magnitudes. Equation (235) is an application of UE as an RT. From this equation, we can exactly determine the **age** (conventional time) of the **visible universe**:

$$A_U = 1/H_0 = 7.15065 \times 10^{17}\ \mathrm{s} \quad (236)$$

This value has been estimated fairly well on the basis of the Hubble constant (226). It is a modest consolation that modern cosmology is not that bad when it operates as applied mathematics. This conclusion is, however, not surprising - we have stressed on many occasions throughout this volume that mathematics is the only adequate perception of space-time. At present, this basic cosmological constant is empirically determined on the basis of the density of remote galaxies that are separated by immense distances with no visible matter. Therefore, the precision of measurement of H_0 is still not as good as that of the basic physical constants, such as c and G, which can be exactly determined in a local ex-

periment. As space-time is a closed entity, we need only two exact values, preferably a space and a time magnitude of a selected photon system, e.g. the basic photon, to calculate any other magnitude (constant) of space-time without performing extensive and expensive experiments. This conclusion has been intuitively anticipated in the definition and method of measurement of the SI units, *meter* and *second*.

This elaboration eliminates both the unproductive dispute in cosmology about the exact value of H_0 (comprising a large portion of the scientific activities in this discipline) and the necessity of performing superfluous, expensive astrophysical experiments. This example clearly demonstrates the superiority of the new axiomatics over the traditional empirical approach in physics and cosmology. This can be illustrated by a further example.

Einstein's **cosmological constant Λ** is central to the current cosmological view, although he considered it the greatest blunder in his life. We shall show that this constant has its origin in UE of gravitation and has been defined in an abstract way within mathematics. Einstein's model of the universe departs from the theory of relativity and describes space-time, that is, photon level and matter level, as a relationship between mass density ρ = SP(A)/[1*d-space*] and the local change in space. The latter is described as a local rate of expansion $U_U = c^2$ and contraction g_{local} (see equation (37a)). Einstein uses the empty Minkowski's world as a reference frame. To balance the expanding and contracting forces in the universe, he introduces his famous cosmological constant Λ *ad hoc*. Mathematically, it has the dimensionality of **square time** $\Lambda = f^2$. This quantity is obtained within mathematical formalism by applying the differential operation of „divergence" to any energy gradient $\varphi = U$ that is presented as [2*d-space-time*]-quantity: *LRC* = [2*d-space-time*] (see Laplace operator in chapter 4.6):

$$diva = \Delta a = \frac{d^2\varphi}{d^2r} = \frac{U}{r^2} = \frac{LRC}{r^2} = \frac{[2d - space - time]}{[2d - space]} = f^2 \quad (237)$$

$\Lambda = \Delta a = f^2$ is the second derivative of any *LRC* with respect to space. In recent modifications of Einstein's model (Zel'dovich, 1968; Zel'dovich & Novikov, 1983), the cosmological constant is interpreted as a fluid with the **effective mass density** of

$$\rho_0 = \frac{\Lambda}{8\pi G} = \frac{f^2}{8\pi[1d-space-time]f} = \frac{\mathrm{SP(A)}}{[1d-space]} \qquad (237a),$$

where $f^2/8\pi = \mathrm{SP(A)}$. When we solve UE of gravitation for the quantity density, as it is given for the earth in (41), we obtain the same result within the new space-time symbolism:

$$\rho_0 = \frac{3g}{2GS_E} = \frac{3[1d-space-time]f}{2[1d-space-time]f[1d-space]} = \frac{\mathrm{SP(A)}}{[1d-space]} \qquad (238)$$

Einstein's equation of the effective mass density, in which the cosmological constant appears as square time f^2, is a pleonastic variation of the new UE of gravitation within mathematical formalism. The latter is an application of Newton's law of gravity, which itself is an application of the Law for gravitation. Both presentations are mathematical iterations of the quantity „density" (47). The search for an explanation in the mathematical complexity has been the chronic syndrome not only of Einstein, but also of all physicists before and after him and has led to the present intellectual fatigue in this science[45]. For a panacea, we recommend the correct application of the Law.

How can we explain Λ in terms of knowledge? Time is the dynamic constituent of space-time that gives us information on the number of action potentials that are exchanged. If we regard, contrary to Einstein, space-time as inhomogeneous, the local density of the actual space-time of the systems or levels will only depend on the number of action potentials per space $\rho \approx f^2$. The square time assesses time as a product of the interaction between two entities $f^2 = f \times f(\mathrm{AR})$. Thus Einstein's cosmological constant is equivalent to the angular acceleration in its conventional presentation $\Lambda = \alpha = f^2(18)$. The bigger the angular acceleration $\alpha = E = [1d\text{-}space\text{-}time]\ f$, the smaller the space: $E \approx \alpha = E \approx 1/[1d\text{-}space]$. We have shown in quantum mechanics that this is the present mechanism of defining elementary particles - the space of the particles is inversely proportional to their angular acceleration (as E_A) and energy (space-time).

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[45] This is an allusion to CFS (chronic fatigue syndrome) that has emerged as a new disease of modern industrial life and can be successfully treated in the light of the Law (see vol. III).

The time can be set equivalent to the number of revolutions 1 *rev* = 1 E_A, or to any portion of the revolution, e.g. $1^o = 1\ E_A$.

To this mathematical approach we owe the introduction of quantum numbers. We have used this approach to obtain the mass of the elementary particles from the mass of the basic photon (chapter 1.9). The same paradigm is used by Schrödinger in his wave equation, where he describes the energy density of the particles as a function of Planck's constant (chapter 5.2). Whenever we scrutinize the mathematical presentations in physics and cosmology, we come across the same invariant pattern - the pattern of the Universal Law. These two examples are an adequate introduction to the cosmological outlook of traditional physics. This will be the topic of our next chapter.

7.4 THE COSMOLOGICAL OUTLOOK OF TRADITIONAL PHYSICS IN THE LIGHT OF THE UNIVERSAL LAW

The **hot expanding hypothesis** of the standard model assumes that the universe, as observed today, has evolved from a state of homogeneous energy with a negligible space and incredible density which exploded in a small fraction of a second. This state of the universe is described as the „big bang". Since then, the universe has been expanding incessantly. In the context of this cosmological outlook, Hubble's law is interpreted as a „law of expansion". As this law is an application of UE, we must reject this cosmological interpretation on axiomatic grounds. We have shown that Hubble's law assesses the constant space-time of the visible universe. The two natural constants, R_U and $H_0 = 1/A_U$, give the constant space and time of the visible universe. Thus we have eliminated the first basic pillar of the standard model - the interpretation of Hubble's law as a law of expansion. We shall now present additional proofs for this irrefutable conclusion.

The idea of the expanding universe is a consequence of the idea of homogeneous space-time in the theory of relativity. We have shown that Einstein has not completely corrected the empty Euclidean space of classical mechanics, but has only introduced the reciprocity of space and time, as described by Lorentz for electromagnetism, for the systems of matter. Einstein regards the gravitational objects as embeddied in empty and massless photon space-time (vacuum). With respect to the recipro-

city of space and time, he assumes in the general theory of relativity that vacuum can be curved or bent by local gravitation. The current interpretation is that the path of light is attracted by local gravitational potentials and for this reason cannot be a straight line in space. When this space-time concept is applied to cosmology, it inevitably leads to the neglect of the **finite lifetimes** of stars, as they have been described by Chandrasekhar and only later verified in modern astrophysics.

The finite lifetime of any gravitational system is a consequence of the energy exchange between matter and photon space-time. The new axiomatics clearly states that all systems, being superimposed rotations, have a finite lifetime, which is only determined by the condition of destructive interference. During this vertical energy exchange, the space-time of the material levels, such as atom level, electron level, thermodynamic level, etc. is transformed into the space-time of the photon level and vice versa. Photons have a much greater extent than the space of material levels, as can be demonstrated by the constant [1*d-space*]-quantities of their elementary action potentials: the Compton wavelengths of the electron $\lambda_{c,e} = 2.4\times10^{-12}$ m**,** proton $\lambda_{c,pr} = 1.32\times10^{-15}$ m, and neutron $\lambda_{c,n} = 1.32\times10^{-15}$ m are much smaller than the wavelength of the elementary action potential of the photon level $\lambda_A = 3\times10^{8}$ m, or more precisely, in the order of their intrinsic time - the **Compton frequency**:

$$f_{c,e} = \lambda_A/\lambda_{c,e} = 3 \times 10^{8} \text{ m } /2.4263 \times 10^{-12} \text{ m} = 1.236\times10^{20}$$

$$f_{c,pr} \approx f_{c,n} = \lambda_A/\lambda_{c,pr} = \lambda_A/\lambda_{c,n} = 3\times10^{8} \text{ m } /1.32.10^{-15} \text{ m} = 2.27\times10^{23}$$

The [1*d-space*]-quantity of the elementary action potential is a specific constant of the corresponding level. It assesses the space of the level. During the vertical energy exchange between two levels, the extent of space-time changes discretely in specific, constant quantitative leaps. These leaps can be assessed by building space and time relationships between the levels. Such constants are dimensionless numbers. In the new axiomatics, we call them „absolute constants of vertical energy exchange“ (see chapter 7.9). When we observe the vertical energy exchange only in one direction, e.g. from matter to photon space-time, this process is perceived as an **explosive expansion** of space-time. This is precisely the current cosmological view. The thermonuclear explosion is a typical, albeit more trivial example of an energy exchange from the nuclear level towards the photon level, also defined as radiation. This process is asso-

ciated with an extreme space expansion described as a „**nuclear wave**“. The reason for this is the extremely small extent of the hadrons compared to the extent of the emitted photons, as has been demonstrated by the corresponding time magnitudes of these systems of space-time - the Compton frequencies.

When the same vertical energy exchange is observed in the direction from photon space-time to matter, it manifests itself as a **contraction** of space. A typical example of an extreme space contraction are the black holes, which are circumscribed as „space singularities“. Initially, black holes were believed to only „devour“ space and matter. However, this is a violation of energy conservation. Later on, it was proven (within mathematics, because black holes cannot be directly observed) that they emit gamma radiation at their event horizon and thus obey the axiom of CAP, just like all other systems of space-time. This has eliminated the spectacular character of these celestial bodies. The mean frequency of gamma radiation of black holes f_H can be presented as a function of the intrinsic time of the material particles:

$$m_p\, f_H = m_p(\, f_{c,e} + f_{pr,e} + f_{n,e}) \,/3 \tag{239}$$

The high temperature of black holes is another quantity of material time - the time of the thermodynamic level of matter. In chapter 3.5 we have derived the new CBR-constant and have shown that the frequency of the maximal emitted radiation depends only on the temperature of the material body $f_{max} = K_{CBR} \times T$ (82). In the next chapter, we shall use this constant to reject the second pillar of the standard model - the traditional interpretation of the 3*K*-cosmic background radiation (CBR). The 3K-CBR is considered a remnant of the hot radiation of the big bang, which has resulted from the subsequent adiabatic expansion of the universe. This view is presented in the standard model and is closely associated with the erroneous interpretation of redshifts in Hubble's law.

From this elaboration, we conclude that when the vertical energy exchange is observed only one way, that is, from matter to photon space-time, it gives the impression of space expansion. When the energy exchange is considered unilaterally from photon space-time to matter, it gives the impression of space contraction. When both directions are taken into consideration, the total change of space time is zero: $\Delta V_U = 0$, or $V_U = cons$. Space-time remains constant. This is an axiomatic statement of the new theory. It can be easily deduced from the law of conservation

of energy.

In cosmology, photon space-time is regarded as a homogeneous empty void. For this reason this discipline considers the vertical energy exchange between matter and photon space-time only **one way**: from matter that can be observed to empty space, which has no structure and therefore cannot be directly perceived. This one-sided anthropocentric view (human beings are part of matter) automatically evokes the misleading impression that the universe expands in the void. As the finite lifetimes of stars are not considered in this outlook, modern cosmology has no adequate idea of the discrete ubiquitous energy exchange between matter and photon space-time, unlike in the new axiomatics. In chapter 1.7, we have proved that when the axiom of reciprocal *LRCs* is applied to the visible universe, this system of space-time can be described as a function of the *LRCs* of the photon level and the gravitational level. The space of the visible universe given as S_U is proportional to the *LRC* of the photon level $LRC_p = U_U = c^2$, which stands for space expansion, and is inversely proportional to the *LRC* of gravitation as expressed by the gravitational constant G (field or acceleration), which stands for the contraction of space (37a):

$$S_U = c^2/G$$

This simple formula is an application of UE as a rule of three. It embodies the space-time behaviour of the visible universe according to AR. It proves that its circumference is a constant [1*d-space*]-quantity because it is a quotient of two natural constants, c and G, which assesses the two levels - photons and gravitation.

For obvious reasons, cosmology can only assess the space-time of the visible universe and is not in a position to obtain any experimental evidence beyond its event horizon. This is the privilege of the new axiomatics - it assesses the primary term epistemologically and not empirically (priority of axiomatization over empiricism). As we see, the new axiomatics effects an incredible simplification in our cosmological outlook, and rejects the idea of an expanding universe as a false unilateral perception of the energy exchange between matter and photon space-time. This idea has given birth to many paradoxes, which are closely associated with the interpretation of the doppler effect within Hubble's law. This will be the topic of the next two chapters.

7.5 THE ROLE OF THE CBR-CONSTANT IN COSMOLOGY

As already mentioned, the „big bang“ hypothesis of the standard model is based on two pillars: 1) the CBR and 2) the expansion of the universe as assessed by Hubble's law. If these pillars can be interpreted in a different way, for instance, by the Law, then the standard model must be refuted. In the previous chapter, we have explained how the idea of the expanding universe has evolved in cosmology, namely, from the one-sided perception of the vertical energy exchange between matter and photon space-time. In this chapter we shall discuss the interpretational flaws of CBR in modern cosmology.

The experimental confirmation of CBR, as predicted by Gamov on the basis of Friedmann's model and coincidentally discovered by Penzias and Wilson in the sixties, has evoked the mistaken conviction among cosmologists that the theoretical assumptions of the standard model hold true. The key assumption of this model is that, from the very beginning, the universe has been dominated by extremely hot blackbody radiation (hot photon space-time) that has cooled down during the adiabatic expansion of the universe to the present temperature of about 3K - hence the term 3K-CBR. The prediction of 3K-CBR on the basis of wrong assumptions and its subsequent discovery is a curiosity that will certainly enjoy an outstanding place in the future gallery of scientific blunders. The traditional interpretation of CBR as a consequence of the expansion of the universe will be now rejected.

We have shown in chapter 3.5 that the **CBR-constant** which determines the relationship between the temperature of the material body and the frequency of the emitted photons depends on the speed of light and the proportionality constant of Wien's displacement law: $K_{CBR} = c/B$ (82). The constant B is one-dimensional space-time of a novel thermodynamic level of matter that has not been realized so far. In the view of traditional cosmology, the speed of light is a fundamental constant that remained unchanged during the big bang and in the first seconds of expansion. This assumption allows the determination of **Planck's parameters** of the big bang, which are basic to the standard model (see chapter 7.7). According to the standard model, at that time matter did not exist, at least, not in the form it is seen today. This would mean that B did not exist either: $B = 0$, and $K_{CBR} = c/0$ = improbable event (operation not allowed). On the other hand, this constant determines

the frequency of any emitted photon radiation for any temperature of matter, which is, in fact, a time quantity of the thermodynamic level $f_{max} = K_{CBR}T$. If we set for T the temperature of 2.73 K, we obtain exactly the **maximal frequency** of **CBR,** as is experimentally measured by the **COBE satellite**[46]:

$$f_{max} = K_{CBR}\, T_{CBR} = 1.0345 \times 10^{11} \times 2.73 \text{ K} = 2.824 \times 10^{11} \quad (240)$$

If we assume that matter did not exist at the beginning of the universe, we must also accept that there has been no thermodynamic level during the big bang and the short time thereafter. Therefore, the time of this level, the temperature, should not have existed either: T = improbable event (not existent). In this case, we obtain for the time (frequency) of photon space time:

$$f_{max} = \textit{improbable event}\ (K_{CBR}) \times \textit{improbable event}\ (T) =$$

$$= \textit{improbable event} \quad (241)$$

Equation (241) symbolizes the entire nonsense of the standard model. If there has been no matter, there would have been no temperature and subsequently no photon space-time in terms of electromagnetic waves with the time (frequency) and velocity as observed today: $c = f\,\lambda = 0\lambda = 0$. The standard model postulates that c was valid during the big bang (see derivation of Planck's parameter below). However, if there was no photon space-time, there would have been no radiation and thus no CBR as observed today. The assumptions of the standard model have not been challenged yet, only because the epistemological background of space-time, that is, of space and time, is not an object of interest in present-day physics and cosmology. This agnosticism is the origin of all the flaws in cosmology.

On the other hand, if we assume that the universe has evolved gradually by developing new levels, however at time intervals that are infinite in relation to the estimated age of the universe, we can imagine similar conditions in black holes, neutron stars, quasars, pulsars, and other similar material systems of gravitation (see chapter 7.9) to those described

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[46] COBE Science Working Group, Spectrum of the cosmic background radiation, in P.J.E. Peeble, Principles of Physical Cosmology, p. 132.

for the big bang. In this case, we need not extrapolate in the past, as is done in the standard model, but have to consider the finite lifetimes of stars in the context of the energy exchange between matter and photon space-time. When the energy exchange from matter to photon space-time is perceived unilaterally as expansion that is ongoing into the future, we inevitably come to the hypothesis of the big bang when this process is traced back into the past. This false hypothesis follows from the idea that photon space-time is empty and homogeneous. This is the basic epistemological error of physics that engenders all the nonsense in cosmology.

The new axiomatics clearly says that the CBR-constant is an absolute constant of the vertical energy exchange between the thermodynamic (kinetic) level of matter and the thermodynamic level of photon space-time as assessed by Stankov's law (chapter 3.7). Thus the time of the photon level depends on the time (temperature) of matter and vice versa: the temperature of matter depends on the frequency of the absorbed photons. This mutual interdependence can be observed any time in daily life, e.g. the warming of metals by sunbeams and their subsequent radiation as heat. Such phenomena are manifestations of the vertical energy exchange between matter and photons that takes place in both directions (CAP).

Equation (240) holds for any temperature. Black holes and neutron stars are known to have extremely high temperatures. When the frequency of the photons emitted by these gravitational systems is calculated with this equation, we obtain a CBR in the gamma range. Such high-frequency-CBR is regularly observed in astrophysics. Typically, this kind of CBR is not explained as a remnant of the big bang. This illustrates the ambiguity of cosmological interpretations. Equation (240) is a very useful application of the Law, with which we can determine the thermodynamic coefficients of vertical energy exchange of individual stars and other celestial bodies with photon space-time. In the next chapter, we shall show that the redshifts in the doppler effect can be used in the same way to determine the vertical energy exchange between individual systems of gravitation and photon space-time. With respect to the theory of relativity, these absolute coefficients can also be called „relativistic coefficients of energy interaction".

7.6 PITFALLS IN THE CONVENTIONAL INTERPRETATION OF REDSHIFTS

The method of measurement of escape velocity in Hubble's law is the determination of redshifts of selected galaxies. Hubble was the first astronomer to suggest a relationship between his application of UE for the one-dimensional space-time of the visible universe and the redshifts observed by the doppler effect. In chapter 2.6, we have shown that the doppler effect is a ubiquitous phenomenon that demonstrates the reciprocity of space and time. We can use this effect to explain the mechanism of gravitation[47]. Redshifts in visible light are observed when the space of the photon system confined by the source and the observer expands; violetshifts are observed when the space contracts. These changes in space are relativistic and occur simultaneously everywhere in the universe. For instance, one can observe both redshifts and violetshifts of distant galaxies. Altogether, redshifts are predominant. This has led to the idea of using them as a method of measurement of the escape velocity of galaxies in an expanding universe. However, until now modern cosmology has not been in a position to present a theoretical proof that redshifts really measure the expansion of the universe, as is clearly stated in the following quotation[48]:

> "The gravitational frequency and temperature shifts between observers are equivalent to the effects of a sequence of velocity shifts between a sequence of freely moving observers. For the same reason, the surface brightness of an object at a different (gravitational) potential would vary with its redshift...This is **not** a cosmology, however, for it is not known how one could get a reasonable redshift-distance relation from a stable static mass distribution, or what provision one would make for the *apparently finite lifetimes* of stars and galaxies...If the redshifts of quasars did not follow the redshift-distance relation observed for galaxies, it would show we have **missed** something very significant....
> It is sensible and prudent that people **should continue to think about alternatives to the standard model**, **because the evidence**

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[47] This aspect is discussed in the full version of volume II (see Bulgarian translation).

[48] P.J.E. Peeble, Principles of Physical Cosmology, p. 226.

> **is not at all abundant**... The moral is that the invention of a credible alternative to the standard cosmological model would require consultation of a considerable suite of evidence. It is equally essential that the **standard model be subject to scrutiny at a still closer level than the alternatives**, for it takes only **one** well established failure to rule out a model, but many successes to make a convincing case that a cosmology really is on the right track."

We shall now prove that **redshifts** measure the individual energy exchange of any gravitational system with photon space-time and therefore cannot be interpreted as evidence for the expansion of the universe. It is a well established fact that redshifts are a classical test for the validity of the theory of relativity. They are appreciated as the most exact test of this theory. The magnitude of the redshift depends on the magnitude of the local gravitational potential (LRC_G). In the general theory of relativity, the redshift df/f gives the relativistic change of the gravitational potential dU in relation to the *LRC* of photon space-time: $df/f = dU/c^2$. This relationship was first postulated by Einstein in 1911. Since then it has been empirically confirmed by numerous experiments with growing precision. The relativistic formula that is usually employed is an application of UE as an RT:

$$\frac{df}{f} = \frac{dU}{c^2} = \frac{LRC_G}{LRC_P} = \frac{E_G}{E_P} = \mathrm{SP(A)} \tag{242}$$

We shall use the same application in chapter 7.9 to establish the **derivation rule of absolute coefficients** of vertical energy exchange, with which we can build an input-output model of the universe based on dimensionless numbers. This input-output model is equivalent to the continuum of real numbers.

As already discussed, any relativistic presentation is a comparison of the actual space-time of a system with photon space-time (initial reference frame). In this particular case, the local gravitational potential of any celestial body which, according to Einstein, is responsible for the local curvature of the empty homogeneous space-time, is compared to the constant *LRC* of photon space-time. From equation (242), we can obtain the so-called **Schwarzschild radius R_s** when we use Newton's law of gravity to determine the gravitational potential on the surface of a

celestial body (R is the radius of a star, planet, or any other celestial body):

$$\frac{df}{f} = \frac{dU}{c^2} = \frac{GM}{Rc^2} = \frac{R_S}{2R} = \text{SP(A)} \tag{243}$$

This [1*d-space*]-quantity is obtained within geometry and is in reality a diameter (imprecise terminology). The **Schwarzschild radius R_s** is of key importance to the theory of relativity, although this quantity cannot be explained in terms of knowledge. Traditionally, it is regarded as a measure for the relativistic effects of gravitational objects. In the light of the new axiomatics, this space quantity assesses the local absolute coefficients of vertical energy exchange of the individual gravitational systems, such as stars, planets, pulsars, quasars, neutron stars, black holes, etc., with photon space-time. All gravitational systems undergo different states of material arrangement, such as white dwarfs, unstable stars, neutron stars, red giants, etc., as assessed by Chandrasekhar's equation of the boundary conditions of stellar transformation (finite lifetimes of stars). These stellar phases of specific space-time can be expressed by various quantities, such as mass, density, volume, etc., and exhibit different coefficients of vertical energy exchange with photon space-time. From this, we can easily conclude that we can build infinite levels of gravitational objects with respect to their specific vertical coefficient. The local geometry (structural complexity) of the space-time of the visible universe can be precisely described with such local coefficients. This aspect will be further discussed in chapter 7.9. When equation (243) is derived from the universal equation of gravitation, we obtain the following simple application of the Law for the **local gravitation** g_{local}:

$$S_{local} = [1d\text{-}space] = c^2/g_{local} = \textit{world line of local curvature} \tag{244}$$

This is the actual „**universal field equation**" which Einstein was searching for in vain his whole life. It assesses the local curvature of photon space-time in terms of world lines S_{local} (Weltlinien der Krümmung des Weltalls). This [1*d-space*]-quantity is a function of the local gravitational potential, given as the gravitational acceleration or field of the celestial objects of matter. This is, in fact, the only objective of Einstein's general theory of relativity, which is applied geometry of space-time. It could not

succeed, not only because Einstein did not master the complexity of the mathematical instruments (Riemann's topology), but essentially because he did not explain the epistemological background of his theory of relativity. Let us now summarize the key knowledge to accrue from this elaboration:

> The **redshifts** in the doppler effect measure the **local vertical energy exchange** between the **individual gravitational systems** and **photon space-time**. According to PCA, these energy interactions are presented relativistically in comparison to the constant space-time of the photon level (universal reference frame). Therefore, redshifts should not be interpreted as evidence for the expansion of the universe.

The idea of an expanding universe based on redshifts has led to a collection of paradoxes that expose modern cosmology as a system of fallacies. The first paradox is associated with the interpretation of black holes. According to the present view, these gravitational systems exhibit the maximal redshifts that are known at present. This is the current scientific opinion on this issue as expressed in the **uniqueness theorems** of black holes[49], which are applications of the Law within mathematics. If we now argue in the context of Hubble's law, we must assume that black holes are the remotest objects from any observer within the visible universe (cosmological principle). In this case, we must expect to find black holes only near the event horizon of our visible universe. The same holds true for quasars and pulsars, which exhibit about 90% of the redshift-magnitude that has been determined for black holes. However, the experimental evidence in astrophysics does not confirm this conclusion, which follows logically from the current interpretation of Hubble's law. In addition, this would be in breach of the cosmological principle, which postulates an even distribution of celestial objects in the universe. This paradox should be sufficient to reject the standard model on present evidence. It is still a mystery why this has not already been done, even without knowing the Universal Law.

The absurdity of the present interpretation of redshifts as evidence for an expanding universe becomes obvious when we analyze the present

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[49] M Heusler, Black Hole Uniqueness Theorems, Cambridge University Press, 1996.

cosmological view of the age and radius of the „finite“ universe, which is supposed to have emerged from the big bang. The general belief is that the objects with the maximal redshifts are the remotest from the observer. As a consequence, they should be regarded as the oldest material objects in the universe, if we accept the „genesis“ of the universe from the big bang as stated in the standard model. This is explained by the fact that the light coming from such objects should need the longest time to cover the greatest distance before reaching the observer. In this case, this light is of the oldest origin - it has existed from the very beginning of the universe. The remotest objects that emit this light must have been very near to each other in this initial phase. As the universe is believed to have a finite age of about 15-20 billion years, this is considered to be the actual age of the light that comes from the remotest objects with the maximal redshifts. The paradoxical nature of this concept becomes evident when we apply the **deductive method** of the new axiomatics as PCA.

Let us depart from the cosmological principle as an application of PLE for the system „visible universe“. According to it, the above interpretation holds for any observer, at any place, at any time. Let us assume that we are the initial observer placed on the earth. We can now imagine at least one more observer, who is situated between us and the remotest object with the maximal redshift. In this case the second observer will measure redshifts from objects that are beyond our event horizon. The redshifts of such objects cannot be observed from the earth. These objects will have a greater distance from the earth than the remotest objects we can observe from our planet. At the same time they will be older than the oldest objects in the universe, the age of which is set equal to the age of the universe. If we now proceed with this deductive method, we can easily prove that there are objects in the universe that are infinitely remote from us and are thus infinitely old. It is important to observe that the same deductive method is used to define the term „infinity“ in the theory of sets. This method departs from any number to define the infinity of the continuum. In the new axiomatics, we define the infinity of the primary term in an *a priori* manner and then confirm this property in a secondary (empirical) manner by the phenomenology of the parts (U-sets). We have used exactly this second method to prove that space-time is infinite, that is, eternal. This proof should be sufficient to reject the standard model that assumes a finite age of the universe. In fact, we can only measure the finite constant space-time of **our** visible universe. How-

ever, according to the cosmological principle, there are infinite visible universes, just as there are infinite potential observers in space-time.

The idea of the standard model that the universe is finite has led to another fundamental paradox, which has recently emerged from experimental evidence. The age of the universe is estimated by Hubble's law to be about 15 billion years. However, recent empirical data in astrophysics does not fit into this concept. Astrophysicists have established that there are stars that are older than the universe. This is now called the „**mother-child paradox**": the children (stars) are older than the mother (the universe). It is cogent that this fact alone should be sufficient to reject the standard model postulating a finite universe. Again, we are tempted to ask why this has not been done before.

If we now consider the finite lifetimes of stars as described by Chandrasekhar, we must conclude that we are **not allowed** to make any statements on the actual age of material systems, that is, of matter, based on the age of the emitted light. If stars periodically undergo different phases of material organisation, a fact that is beyond any doubt, how can we know their actual age if we can only determine the age of the light emitted during a certain phase of transition (see also quotation above)? For instance, when we register a light signal from a nova that is, let us say, seven billions years old, we can only say that 7 billions years ago, that is, at a time when the earth probably did not exist, this particular star had this material configuration. As novae are **recurrent stars**, we cannot know their past or present states. For instance, there is no way of knowing how many transitions this nova has undergone in the past, that is, how old it really is. These arguments are based on common sense and are accessible even to the layman. This cannot be claimed for the arguments of modern cosmology[50].

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[50] In the last few years, there has been a growing number of publications on cosmology that document the epistemological mess in this discipline. It is futile to discuss them. We shall only mention one title of a recent book that is symbolic for this state-of-the-art: T. Ferris „The Whole Shebang, A State-of-the-Universe(s) Report", Weidenfeld & Nicolson, London, 1997 (In this context, it is quite amusing to observe how many cosmologists earnestly believe in the existence of many universes.).

7.7 WHAT DO „PLANCK'S PARAMETERS OF BIG BANG" REALLY MEAN (ND)?

When we extrapolate the hypothetical expansion of the universe in the past, we reach a point where the universe must be presented as a „space singularity". This state of the universe is called „big bang" in the standard model. In this spaceless state, matter (energy) is believed to have been a homogeneous entity of extremely high density and temperature (see chapter 7.8). One postulates in an *a priori* manner that during this initial phase of universal genesis only three natural constants remained unchanged: the speed of light *c*, the gravitational constant *G*, and Planck's constant (the basic photon) *h*. Modern cosmology gives no explanation for this subjective preference.

We have already met a similar concept to the big bang in classical mechanics - the mass point. While the mass point is an abstraction (object of thought) of real objects within geometry obtained by means of integration, the big bang is a mathematical abstraction of the whole. The prerequisite for this assumption is that space is empty and homogeneous. This error is introduced in cosmology through Einstein's theory of relativity, but it goes back to Newton's Euclidean space of classical mechanics, which Einstein failed to revise (see section 6).

The standard model results from physics' genetic failure to define the primary term from an epistemological point of view. Although the big bang is an object of thought and never existed, cosmologists earnestly believe that they can mathematically describe this condition by the so-called „**Planck's parameters**". This name comes from Planck's equation, which is used for the derivation of these quantities. The calculation of the hypothetical parameters of the big bang is another outstanding flaw in modern cosmology of great didactic and historical value, comparable only to the medieval religious dogma postulating that the earth is flat and represents the centre of the universe. Before we discuss Planck's parameters of the big bang, a few words on the history of the standard model.

If we define Einstein as the „grandfather" of modern cosmology, we should look upon de Sitter as the father of this discipline. The „**Einstein-de Sitter universe**" is the first mathematical model of the universe that is still considered an adequate introduction to this discipline. While „Einstein's universe" is static, but contains matter (space-time relationships),

„de Sitter's universe" is dynamic, but completely empty. This is, at least, Eddington's interpretation. This model became famous because it implied the big bang as the moment of genesis. The term „big bang" was only established in 1950, when Fred Boyle mentioned it for the first time in a publication. The scientific penetration of this model began ten years earlier and gained momentum in the sixties. The Russian scientist, Friedmann, was the first to introduce the idea of an expanding universe in his mathematical model (1922). Departing from the theory of relativity, he destroyed Einstein's hopes of establishing a single irrevocable model of the universe. Instead, Friedmann presented three possible solutions (objects of thought), depending on the magnitude of the quantities used (see chapter 7.3). As his work remained unnoticed during the Russian civil war, the Belgian priest, Lemaître, was the first to popularize this concept in the West.

The pre-war heritage of cosmological ideas in physics was further developed by Gamov, a student of Friedmann, under more favourable conditions after the war. He was the actual father of the standard model. The explosion of modern cosmology began in the seventies, and the diversity of conflicting ideas born in this period reached a state of inflation in the eighties. The nineties can be characterized as a period of prolonged stagnation that has been abruptly terminated by the discovery of the Law. This is the short and not so glamorous history of this new physical discipline.

The three Planck's parameters, which are believed to assess precisely the initial conditions of the universe, are: **Planck's mass, Planck's time**, and **Planck's length**. As we see, cosmologists have also recognized the simple fact that the only thing they can do is to measure the time, space, or space-time relationships of the systems - be they real or fictional. The theoretical approach to the „big bang parameters" departs from the Heisenberg uncertainty principle, that is, from the basic photon, as discussed at length in chapter 5.3. The basic photon with the mass m_p can be regarded as the **elementary momentum** of the universe:

$$p = m_p c = 2.21 \times 10^{-42}\ \text{kgms}^{-1} \tag{245}$$

The mass of the basic photon is calculated by applying CAP, for instance for its energy interaction with the electron as measured by the Compton-scattering $E_{A,e} = m_e c\lambda_{c,e} = h = m_p c\lambda_A$; hence:

$$m_p = h/c^2 = h/c\lambda_A \tag{246}$$

In cosmology, the axiom of CAP is applied for the fictive interaction between the basic photon *h* and the hypothetical big bang, where the latter is regarded as another distinct action potential $E_{A,big\ bang} = m_{pl}c\lambda_c = h = m_pc\lambda_A$. From this, **Planck's mass** m_{pl} of the big bang is determined according to equation (246):

$$m_{pl} = h/c\lambda_c = m_pc\lambda_A/c\lambda_c \tag{247}$$

Cosmology gives absolutely no explanation as to why this equivalence has been chosen for the determination of the abstract quantity „Planck's mass". Therefore, equation (247) should be considered a subconscious, irrational application of the axiom of CAP. The wavelength λ_c ([1*d-space*]-quantity) from equation (247) is defined as **Planck's length** of the big bang $l_{pl} = \lambda_c = [1d\text{-}space]$. For this reason we can also call it the „Compton wavelength" of the big bang, analogously with the Compton wavelengths of the elementary particles. In the light of the new axiomatics, it is a one-dimensional space quantity of the hypothetical space-time of the big bang:

$$l_{pl} = \lambda_c = [1d\text{-}space] \text{ of the big bang} \tag{248}$$

The above equations demonstrate that the description of the space-time of the hypothetical big bang departs intuitively from the correct notion of the Law. It is the origin of all scientific ideas, which are of mathematical origin. However, the interpretation of such mathematical ideas at the rational level is full of logical flaws that vitiate all known systems of science.

Planck's mass in equation (247) can be calculated only after Planck's length λ_c of the big bang is known. What is the traditional approach of modern cosmology to this problem? As expected, it departs from the event horizon *l* of the big bang as K_s of this system. In this sense, the **Planck length** $l_{pl} = \lambda_c$ and the event horizon *l*, expressed as radius, are set equivalent (definition within mathematical formalism):

$$l = l_{pl} = \lambda_c \tag{249}$$

The event horizon *l* of the big bang is calculated by applying the same derivation of UE as used for the Schwarzschild radius

$R_s/2 = GM/c^2$ (243):

$$l = Gm_{Pl}/c^2 \tag{250}$$

In chapter 7.6, we have shown that this application of UE assesses the absolute coefficients of the vertical energy exchange between individual gravitational systems of matter and photon space-time. In this sense, the big bang is regarded as a hypothetical system of matter. This is in apparent contradiction with the standard model, which considers the big bang as a state of condensed homogeneous radiation. According to this model, matter has evolved at a later stage. This is another paradox of the standard model. From the above equations, we can derive **Planck's length**:

$$l_{Pl}^2 = \lambda_c^2 = Gh/c^3 \tag{251}$$

Some authors prefer to use $h/2\pi$ instead of h. This is their degree of mathematical freedom. In this case, the value of Planck's length is 2π times smaller than in equation (251). The method of measurement of this space quantity is irrelevant from a cognitive point of view, as the big bang never existed - it is an abstract mathematical object.

Equation (251) contains the three natural constants, *c*, *G*, and *h*, that have been postulated to hold in the big bang. This is a vicious circle - it is a posterior adaptation (manipulation) of the physical world to comply with their mathematical derivation (after all, cosmologists have to perform some derivations and, to do so, they need certain natural constants.). This approach, defined as „fraud" in science, is not as seldom as generally believed[51].

The three constants assess the space-time of the photon level, which itself is determined by the space-time characteristics of gravitational matter. This basic proof for the closed character of space-time will be presented in chapter 7.9. We shall show that the properties of photon space-time, as assessed by the magnetic field length $l_{\mu 0}$ (110) and the electric acceleration or field E_0 (109), depend on the average rotational characteristics of the gravitational systems in the universe, such as black holes, quasars, pulsars, neutron stars, etc. According to the standard model, these gravitational systems were not developed in the initial phase of the

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[51] S. Lock & F. Wells, Fraud and Misconduct in Medical Research, BMJ Publishing Group, 1993, London.

universe. They have emerged at a much later stage, during the epoch of hadrons (see Table 7-1). This assumption also illustrates the absurdity of the standard model.

Equation (251) can be solved for the universal gravitational potential $E_{AU} = c^3/G$ (30). When we set the reciprocal of this action potential $1/E_{AU} = G/c^3$ in (251), we obtain for Planck's length the following remarkable equation:

$$l_{Pl} = \sqrt{\frac{Gh}{c^3}} = \sqrt{\frac{h}{E_{AU}}} = 4{,}05.10^{-35}\ \text{m} \tag{252}$$

According to modern cosmology, Planck's length is the square root of the quotient of the two fundamental action potentials of space-time: the basic photon ***h*,** which is the smallest (elementary) action potential we know of, and the universal action potential $\boldsymbol{E_{AU}}$, which is the aggregated product of all underlying action potentials with respect to the SI unit of time 1 s^{-1}. We can derive from *h* the space-time of all elementary particles (see Table 1) and from E_{AU} - the space-time of the visible universe. Thus Planck's length is a quotient (relationship) of the [1*d-space*]-quantities of the smallest and the biggest action potential of the universe with respect to the SI unit 1 *second* (building of equivalence) according to PCA:

$$l_{Pl} = \sqrt{\frac{h}{E_{AU}}} = \sqrt{\frac{\text{SP(A)}\left[2d-space\right]_h f_h}{\text{SP(A)}\left[2d-space\right]_{E_{AU}} f_{E_{AU}}}} =$$

$$= \frac{\text{SP(A)}\left[1d-space\right]_h}{\text{SP(A)}\left[1d-space\right]_{E_{AU}}} = \text{SP(A)} \tag{253}$$

In (253) the time of the basic photon is set equivalent to the time of the universal action potential per definition with respect to the SI system $f_h = f_{EAU} = 1\ s^{-1} = \text{SP(A)} = 1\ unit$ = certain event. Equation (253) by no means confirms the existence of the big bang, but simply illustrates the ubiquitous validity of PCA as a method of definition and measurement of physical quantities. Indeed, it is impossible to perceive why the com-

parison of the smallest and the biggest action potential of space-time should be a proof for the existence of the big bang. Both action potentials assess the constant space-time as manifested by the parts today and none of these quantities could have existed in the space singularity of the big bang. This is cogent when the space magnitudes of the two potentials are compared with the magnitude of Planck's length of the big bang. We leave the proof of their incommensurability as an exercise for the reader.

The above derivations of Planck's parameters from the Law illuminate the entire nonsense of the standard model. They explain the background of the epistemological flaws in cosmology. The universal action potential E_{AU} tells us that, every second, the mass (space-time relationship) of $M = 4{,}038{\times}10^{35}$ kg is exchanged between matter and space-time. If photon space-time is regarded as empty, massless, homogeneous space or vacuum, as is done in cosmology today, then it is quite logical to neglect the energy exchange from photon space-time to matter and to consider only the energy exchange from matter to photon space-time. This energy exchange is associated with expansion. If at the same time the finite lifetimes of stars are neglected, the only possibility of explaining this fictional expansion is to assume that the universe has been subjected to an **adiabatic expansion** from its very beginning. However, it remains a mystery where the space that fills the gaps between the escaping galaxies comes from. Although this question is obvious in terms of common sense, it is not posed in modern physics. This is another typical example of the self-inflicted cognitive misery of modern cosmology.

The linear extrapolation of this hypothetical adiabatic expansion of the universe in the past ends up inevitably with a spaceless point, the „big bang" (the name is of no importance), where all known physical laws as determined today lose their validity. While this moment of „virtual genesis" may suit some popular religious beliefs, it has nothing to do with an objective science that should understand the object of its study.

Once Planck's length is computed, one can quite easily determine any other quantity of the hypothetical big bang because UE is an RT. For instance, we obtain the following value for **Planck's mass**:

$$m_{pl} = h/cl_{Pl} \cong 5.5 \times 10^{-8} \text{ kg} \tag{254}$$

The same result is obtained when the mass m_p of the basic photon is used:

$$m_{pl} = m_p \lambda_A / l_{Pl} = 0.737 \times 10^{-50}\ \text{kg} \times 3 \times 10^{8}\ \text{ms}^{-1} / 4.05 \times 10^{-35}\ \text{m} =$$

$$= 5.5 \times 10^{-8}\ \text{kg} \qquad (255)$$

Equation (255) demonstrates that the basic photon is the universal reference system of physics according to PCA. From Planck's length, one can easily obtain the hypothetical magnitude of the second constituent - **Planck's time** t_{pl}:

$$t_{pl} = l_{pl} / c \ \cong 1{,}35 \times 10^{-43}\ \text{s} \qquad (256)$$

According to modern cosmology, the three Planck's parameters completely describe the big bang. It maintains that all physical laws have „lost their validity" in this hypothetical condition, except the three constants, *c*, *G*, and *h*, with the help of which the Planck's parameters of the big bang are computed. However, we have shown that all known natural constants and physical laws can be derived from each other, or more precisely, from the constants of photon space-time: *c*, *G*, and *h.* Therefore, we must conclude that all laws were *valid* during the big bang. The only possible consequence of this conclusion is that **there has been no big bang**. What is the view of modern cosmology on this issue? If we try to learn more about this exotic initial phase of the universe, we are consoled by such sibylline statements[52]:

> "The relativistic space-time (of the big bang) is then no longer a continuum, and we even need a new theory of gravitation - of quantum gravitation or supergravitation."

Considering the fact that physics has no theory of gravitation, it sounds rather strange to demand a new theory of „quantum gravitation" or „supergravitation", whatever that means. Isn't it much more simple to discard the standard model, as has been done in this section? In order to complete our analysis, we shall finally scrutinize the concept of the adiabatic expansion of the universe as a complementary aspect of the big bang.

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[52] PA Tipler, p. 1478, German ed.

7.8 ADIABATIC EXPANSION OF THE UNIVERSE

In chapter 3.6 we have pointed out that there is no such thing as „adiabatic expansion“. It is an abstract idea similar to the concept of potential energy in classical mechanics. As space and time are canonically conjugated, reciprocal magnitudes, any change in one constituent leads automatically to a change in the other. Adiabatic expansion contradicts the reciprocity of space and time. When the space of a system expands, time decreases and subsequently all space-time (energy) quantities which contain the quantity time in the numerator. The adiabatic expansion is based on the idea that the space of a system can expand, but that the pressure $P = F/A = \mathrm{SP(A)}[1d\text{-}space\text{-}time]\ f\ /[2d\text{-}space] = \mathrm{SP(A)}\ f^{\,2}/[1d\text{-}space] = \sigma =$ *tensile stress* (48) remains constant. As pressure is a quantity of space-time that is proportional to time $P \approx f^{\,2} \approx 1/[\mathrm{space}]$, any expansion is associated with a reciprocal change in pressure. Adiabatic expansion is thus a mathematical idealisation.

In practice, the expansion of a system can occur with a minimal change in pressure at the material level when the net energy change is transformed into photon energy, e.g. by radiation. In this case, the change in space-time can no longer be observed in a direct way at the material level. This gives the impression of an adiabatic expansion. While this concept may be useful in engineering, it is a completely wrong idea when applied to the universe. The adiabatic expansion of the universe implies a net change in space-time and thus contradicts the law of conservation of energy, which is an aspect of the Law and is confirmed by all physical phenomena. Thus the concept of the adiabatic expansion of the universe which is basic to the standard model must be rejected on theoretical grounds. The source of this flaw is the unknown nature of the primary term - the reciprocity of space and time. However, this concept has a second aspect, which reveals that cosmologists have intuitively assessed the Law for the visible universe, but, as usual, have interpreted it wrongly.

The standard model explains the adiabatic expansion of the universe with the doppler effect in conjunction with CBR. During the big bang and in the short period of time after this event, the universe is believed to have been extremely hot and the frequency of the initial photon radiation extremely high. This relationship between T and f is assessed by the new CBR-constant and is explained by the Law (chapter 7.5). During the subsequent adiabatic expansion of the universe, the temperature and the wavelength of the radiation should have gradually decreased

$f_{max} = K_{CBR}\ T$. In terms of the doppler effect, this adiabatic expansion has led to a global redshift of photon space-time, the magnitude of which has been growing from the past to the present and will continue to do so in the future. The present 3K-CBR should be regarded as the interim product of this process. Its temperature will continue to decrease in the future. This will inevitably lead to the thermodynamic death of the universe. This is the conclusion of the second law of thermodynamics when it is applied to the growth of entropy in the universe. If, however, we assume that the universe may begin to contract some time in the future, then we shall observe a global violetshift of photon radiation. It is obvious that this assumption cannot be confirmed by any experiment.

According to this circular view, the adiabatic cooling of photon space-time that has led to the observed 3K-CBR is a remnant of the big bang. In the standard model, this adiabatic process is subdivided into several development phases of the universe. They are described in remarkable detail, as if they really have occurred and have been experimentally observed by cosmologists. In this respect, the standard model cannot be distinguished from science fiction. We shall not discuss these hypothetical phases. Instead, we shall concentrate on the hypothetical magnitudes of space and temperature (time), which the standard model specifies for these phases. They are summarized in Table 7-1:

Table 7-1: Development phases of the universe according to the standard model[53]

Epoch	Radius (R_U) (m)	Temp. (T) (K)	Space-time (v) $v = R_U T =$ [1*d-space*] $f =$ [1*d-space-time*] = = *constant*
Epoch of stars	10^{26}	3	10^{26}
Epoch of radiation	10^{23}	10^{3}	10^{26}
Epoch of nuclear reactions	10^{17}	10^{9}	10^{26}
Epoch of hadrons	10^{14}	10^{12}	10^{26}

[53] Modified according to R. & H. Sexl, Weiße Zwerge-Schwarze Löcher, Table 10, p. 131.

Table 7-1 gives the four hypothetical phases (epochs) in the development of the universe from the big bang to the present state according to the standard model. They are defined with respect to the mean temperature and space (radius) of the universe for each epoch. We have shown that the temperature is a quantity of thermodynamic time (chapter 3.1). Thus the radius of the universe [1*d-space*] and the temperature T assess the magnitudes of the two constituents for each development phase of the universe. Their product gives the one-dimensional space-time of the universe. The last column in the table shows that this product is constant for each epoch $\mathsf{v} = R_U T = [1d\text{-}space]\ f = [1d\text{-}space\text{-}time\ ] = cons. \cong 10^{26}$. We obtain the same result if we multiply the radius of the universe with the 3K-temperature of CBR: $\mathsf{v} = R_U T_{CBR} = 2.14{\times}10^{26}{\times}3 = 6.42{\times}10^{26}$. This result illustrates that the adiabatic expansion of the universe is a subconscious, intuitive perception of the constant space-time of the visible universe, which is erroneously interpreted at the rational level.

7.9 DERIVATION RULE OF ABSOLUTE CONSTANTS (ND)

The **derivation rule** of **absolute constants** of vertical and horizontal energy exchange is an application of the Law as an RT. These constants are **dimensionless** space-time (energy) quotients that compare the space and time relationships of the various levels of space-time according to PCA. The derivation rule is a **mathematical formalism** based on a knowledge of the primary term. It makes use of the conventional applications of UE, such as Newton's law, Coulomb's law, Planck's equation, etc., which are built according to AR. These derivations of the Law assess the energy exchange between any two systems of a level. As any energy interaction is a U-set, the mathematical presentation of such interactions implicitly involves vertical energy exchange. Any assessment of an energy interaction is a measurement of the constant space, time, or space-time relationships of the interacting systems with respect to a system of reference (PCA). Such constant relationships are usually presented as **natural constants** - all conventional laws include such constants. Normally, the constants are obtained by building constant relationships with the experimentally observed values, which are presented as **variable parameters**. Such relationships may pertain to a conventional physical law or an application thereof. The variable parameters are space and

time magnitudes, or a combination of both. They are first defined within mathematics and only then measured in an experiment, which always assesses a particular energy exchange. Any measurement is an energy interaction *per se*. For instance, the measurement of the changing distance (e.g. as velocity) between any two objects that exert gravitational forces, or the duration of a chemical reaction, are specific energy interactions.

The derivation rule produces absolute constants, with which space-time can be expressed as a numerical **input-output model** of the power of the continuum. We shall use this rule to derive the famous **Sommerfeld's constant α of fine structure**. It is one of the few dimensionless constants known at present. We shall show that this constant assesses the vertical energy exchange between the electron level of matter and the photon level. The space-time of the **electron level** E_e can be assessed by Coulomb's law as a horizontal interaction between two electrons (action potentials) according to AR:

$$E_e = F_e r = \frac{e^2}{4\pi\varepsilon_0 r} = \mathrm{SP(A)}[2d - space - time]_{\mathrm{e}} \qquad (257),$$

where r is any distance between the electrons. The energy of the **photon level** E_p can be given by Planck's equation for any photon system described as a rotation within geometry:

$$E_p = \hbar f = \frac{h}{2\pi} f = \frac{hc}{2\pi\lambda}, \left(f = c/\lambda\right) \qquad (258)$$

The conventional epistemological approach to this presentation is as follows: the photon is regarded as a „virtual photon" that is incessantly exchanged between two interacting electrons. In terms of the new axiomatics, photons are mediators of horizontal energy exchange between electrons as assessed by Coulomb's law. Any horizontal interaction involves a vertical energy exchange, as given by Planck's equation for the photon level. According to CAP, the energy of the virtual photon which is exchanged between the two interacting electrons is equivalent to Coulomb's energy of the electrons as given in (257). If we now build a **quotient** $K_{1,2}$ between the energies (space-times) of the two levels, E_e and E_p, according to PCA, we obtain the **absolute constant** of vertical en-

ergy exchange between the **electron level** and the **photon level**:

$$K_{1,2} = \frac{E_e}{E_p} = \frac{e^2}{2\varepsilon_0 hc}\left[\frac{\lambda}{r}\right] = \mathrm{SP(A)} \tag{259}$$

At this point, we apply the actual **derivation rule** of **absolute constants**. It is based on an *a priori* knowledge of the properties of space-time. The two [1*d-space*]-quantities of the electron level r and the photon level λ are presented separately in parenthesis. They assess the space of the two levels or systems: the resultant electric system from the interaction of two electrons at the *distance r* and the virtual photon exchanged during this interaction with the *wavelength* λ.

Equation (259) is an application of UE as an RT and holds for any electric and photon system. The two systems can be regarded as action potentials of their levels (degree of mathematical freedom). According to CAP, the energy of the first action potential is completely transformed into the energy of the second action potential. In this case, the constant space of the electric system given as r is completely transformed into the constant space of the virtual photon given as λ. We can express this equivalence (conservation of space-time) in a formal mathematical way by eliminating the [1*d-space*]-quotient in the parenthesis.

In reality, the two [1*d-space*]-quantities build a **constant** dimensionless relationship. As space-time consists only of space and time, this relationship is also contained in the constants that build the quotient in front of the parenthesis. These quantities are conventionally expressed as natural constants with SI dimensions, e.g. electron charge e, permettivity of free space ε_0, Planck's constant (basic photon) h, and speed of light c. By employing the new space-time symbolism, we have proved that these constants are also dimensionless quotients. From this we conclude:

> The **derivation rule** of **absolute constants** $\boldsymbol{K}_{1,2}$ allows the simple derivation of **dimensionless (absolute) constants** from conventional constants given in SI units. In this way, all known natural constants can be expressed as absolute constants within mathematical formalism. This leads to the elimination of the SI system as an anthropocentric surrogate and allows the expression of space-time as a numerical **input-output model** that is equivalent to the continuum.

For instance, when we eliminate the quotient in the parenthesis of equation (259), we obtain the famous **Sommerfeld's constant** of **fine structure** as a quotient of known constants:

$$\alpha = \frac{E_e}{E_p} = \frac{e^2}{2\varepsilon_0 hc} = \frac{1}{137{,}036} \tag{260}$$

> **Sommerfeld's constant of fine structure** is an absolute constant of the vertical energy exchange between the electron level and the photon level which is obtained by the novel derivation rule.

The transitiveness (equivalence) between the new axiomatics and the conventional presentation of physical quantities in the SI system (in SI dimensions and units) becomes cogent when we express Sommerfeld's constant in the new space-time symbolism:

$$\alpha = \frac{E_e}{E_p} = \frac{e^2}{2\varepsilon_0 hc}\left[\frac{\lambda}{r}\right] =$$

$$= \frac{\mathrm{SP(A)}^2\left[2d-space\right]\times\left[1d-space-time\right]f}{\mathrm{SP(A)}\left[2d-space\right]f\left[1d-space-time\right]}\left[\frac{\left[1d-space\right]}{\left[1d-space\right]}\right] =$$

$$= \mathrm{SP(A)} \tag{261}$$

Sommerfeld's constant plays a key role in QED. This discipline of quantum mechanics is based on two fundamental constants, m_e and the coupling constant e (should not be confused with the electron charge). Within mathematical formalism (theory of probabilities), the constant e is defined as the **average probability amplitude** with which a real electron absorbs a real photon and emits it at the same time. The mathematical method of definition is known as the „sum over the histories", and was first introduced by R. Feynman. Together with Tomonoga and Schwinger, he is one of the founders of **quantum electrodynamics** (QED). However, Sommerfeld's constant cannot be explained by QED in terms of

knowledge. This creates insurmountable cognitive problems for quantum physicists as confessed by Feynman himself:

> "There is a most profound and beautiful question associated with the observed coupling constant, *e* - the amplitude for a real electron to emit or absorb a real photon. It is a simple number that has been experimentally determined to be close to –0.08542455. (My physicist friends won't recognise this number, because they like to remember it as the inverse of its square: about 137.03597 with an uncertainty of about 2 in the last decimal place. It has been a mystery ever since it was discovered more than fifty years ago, and all good theoretical physicists put this number up on their walls and worry about it.) Immediately you would like to know where this number for a coupling constant comes from: is it related to π, or perhaps to the base of natural logarithms? Nobody knows. It's one of the *greatest* damn mysteries of physics: *a magic number* that comes to us with no understanding by man. You might say the "hand of God" wrote this number, and "we don't know how He pushed His pencil". We know what kind of a dance to do experimentally to measure this number very accurately, but we don't know what kind of a dance to do on a computer to make this number come out - without putting it in secretly."[54]

In the light of the Law, this „greatest mystery" of physics finds a simple solution. The coupling constant *e* is the reciprocal of Sommerfeld's constant and is thus a simple coefficient of vertical energy exchange between the electron level and the photon level. There are infinite absolute constants of nature which assess constant space-time relationships between systems and levels. Their method of definition is mathematics. Such quotients can be expressed as probabilities that belong to the physical probability set $0 \leq SP(A) \leq 1$. Physics, including QED and QCD, is mathematics applied to the physical world. This is the simple message of the Law. This has not been realized so far.

Within the new axiomatics we can express Sommerfeld's constant in a new way:

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[54] R.P. Feynman, QED, The Strange Theory of Light and Matter", Penguin Books, 1985, p. 129.

$$\alpha = \frac{e^2}{2h} f_U \tag{262}$$

This presentation gives additional valuable information on photon space-time. The time quantity f_U in (262) is called **universal photon time**. Its magnitude can be easily obtained from the electric acceleration of photon space-time (109):

$$f_U = \frac{\mathsf{E}_0}{c} = \frac{0.11294 \times 10^{12}}{2.9979246 \times 10^8} = 0.37673 \times 10^3 \tag{263}$$

The universal photon time f_U is a **new** natural constant that is obtained for the first time in physics (see Table 1). Equation (263) is derived from Maxwell's equation of the speed of light (105). This new constant assesses the **mean angular frequency of the rotation of stars, pulsars, and other major gravitational systems of matter in the universe**. For instance, it corresponds very well with the predicted rotational frequency of **neutron stars** (pulsars) $\omega \cong 10^3$ - 10^4 s^{-1} when the radius of these gravitational systems is estimated to be about $R \cong 5\times10^4$ - 5×10^5 m.[55] This [1*d-space*]-value is very close to the magnitude of the magnetic field length $l_{\mu 0}$ of photon space-time (110) $l_{\mu 0} = 7.95775\times10^5$ m $\cong 2R = R_s$ == *Schwarzschild radius*, which is another new fundamental cosmological constant (chapter 4.3).

Equation (263) proves that the rotational kinetics of photon space-time as assessed by electromagnetism (Maxwell's equation of the speed of light) is **determined** by the rotational kinetics of celestial bodies, mainly by black holes, neutron stars (pulsars), and less so by normal stars such as our sun ($\omega = 3.10^{-6}$ s^{-1}). This can be illustrated by the following example. The magnetic field B (143) of pulsars is estimated to be about 10^8 tesla (between 10^6 - 10^8 tesla)[56]. We have shown that the magnetic field of the earth is about 10^{-4} tesla for one revolution, that is: $B_{earth} = 1$ rev $\cong 10^{-4}$ tesla $\cong 10^4$ s (144). If we want to know the angular frequency of pulsars, that is, the number of revolutions of pulsars per second, we simply have to multiply their magnetic field with the mag-

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[55] R. & H. Sexl, chapter 5. p. 64-70.

[56] R. & H. Sexl, chapter 5.2, p. 69; J. Herrmann, Wörterbuch zur Astronomie, dtv, München, 1996, Pulsare, p. 392-394.

netic field of the earth:

$$\omega_{pulsar} = f = B_{pulsar} \times B_{earth} \cong 10^8 \text{ tesla} \times 10^{-4} \text{ tesla} =$$

$$= 10^4 \text{ tesla} = 10^4 \text{ s}^{-1} = \text{SP(A)} \qquad (264)$$

This value corresponds to the predicted angular frequency of pulsars as estimated by the new constant f_U (263). As we see, physics has introduced a variety of pleonastic expressions that assess the space and time of celestial objects. The above derivations are a fundamental proof that,

> while space-time is a closed entity, its systems and levels are open and mutually determine their constant space and time.

In this particular case, the rotational kinetics of electromagnetic photon space-time is determined by the rotational kinetics of the gravitational systems of matter:

> The wave character of photon space-time as expressed by the speed of light

$$c = \mathsf{E}_0 / f_U = \sqrt{l_{\mu_o} \mathsf{E}_o} = f_U l_{\mu 0} = [1d - space - time]_p \qquad (265)$$

> in electromagnetism is determined by the **average rotational space-time** of gravitational systems, such as black holes, pulsars, quasars, stars, etc. (CAP):

$$c = \mathsf{v} = f_U \, l_{\mu 0} = 2\omega_{ave} \, R_{ave} = [1d\text{-}space\text{-}time]_G \qquad (266)$$

This is the simple cognitive basis of the **new cosmology** of the Law. Equations (265) and (266) are basic proofs that all motions of space-time are **superimposed rotations** (U-sets). They integrate cosmology, electromagnetism, and quantum mechanics and establish a numerical input-output model of the universe:

$$primary\ term = space\text{-}time/energy = universe =$$

$$= \textit{input-output model} = \textit{continuum} \tag{267}$$

This is the ultimate simplification of physics and cosmology based on the Law.

The derivation rule can be used to obtain the following **new** absolute constants of vertical energy exchange (the first constant is known):

a) The **fine structural constant of gravitation** K_G assesses the vertical energy exchange between the gravitational proton level (Newton's law of gravity) and the photon level as given in Chandrasekhar's equation of finite lifetimes of stars.

$$K_G = \frac{E_G}{E_p} = \frac{G m_{pr}^{\ 2}}{\hbar . c} \cong 6 \times 10^{-39} \tag{268}$$

b) The new **absolute constant of thermodynamics** $\boldsymbol{K_T}$ assesses the vertical energy exchange between the thermodynamic levels of matter (Boltzmann's law) and photon space-time (Stankov's law).

$$K_T = \frac{dK_{(ave)}}{dE_p} = \frac{3}{2}\frac{k_b}{K_S} \cong 0.3017 \tag{269}$$

c) The new **absolute constant of thermoelectric exchange** $\boldsymbol{K_{TE}}$ assesses the vertical energy exchange between the electron level (Coulomb's law) and the kinetic, thermodynamic level of matter (Boltzmann's law).

$$K_{TE} = \frac{E_e}{K_{(ave)}} = \frac{e^2}{6\pi\varepsilon_0 k_b} \cong 1.1 \times 10^{-5} \tag{270}$$

d) The new **absolute constant of thermogravitational exchange** $\boldsymbol{K_{TG}}$ assesses the vertical energy exchange between the gravitational proton level (Newton's law of gravity) and the kinetic, thermodynamic level of matter (Boltzmann's law).

$$K_{TG} = \frac{E_G}{K_{(ave)}} = \frac{2Gm_{pr}{}^2}{3k_b} \cong 9.018771 \times 10^{-42} \tag{271}$$

e) The new **absolute constant of electrogravitational exchange K_{EG}** assesses the vertical energy exchange between the gravitational proton level (Newton's law of gravity) and the electron level of matter (Coulomb's law).

$$K_{EG} = \frac{E_G}{E_e} = \frac{Gm_{pr}{}^2 4\pi\varepsilon_0}{e^2} = 8.106 \times 10^{-37} \tag{272}$$

We can express the above constants in the new space-time symbolism and prove that they are dimensionless relationships. We leave this exercise to the reader. The number of such constants is infinite because space-time is infinite. The same holds true for the degree of mathematical freedom, which is the source of any physical quantity. This is the epistemological background of the Law that leads to the axiomatization of all natural sciences to a **General Theory of Science** based on the Law.

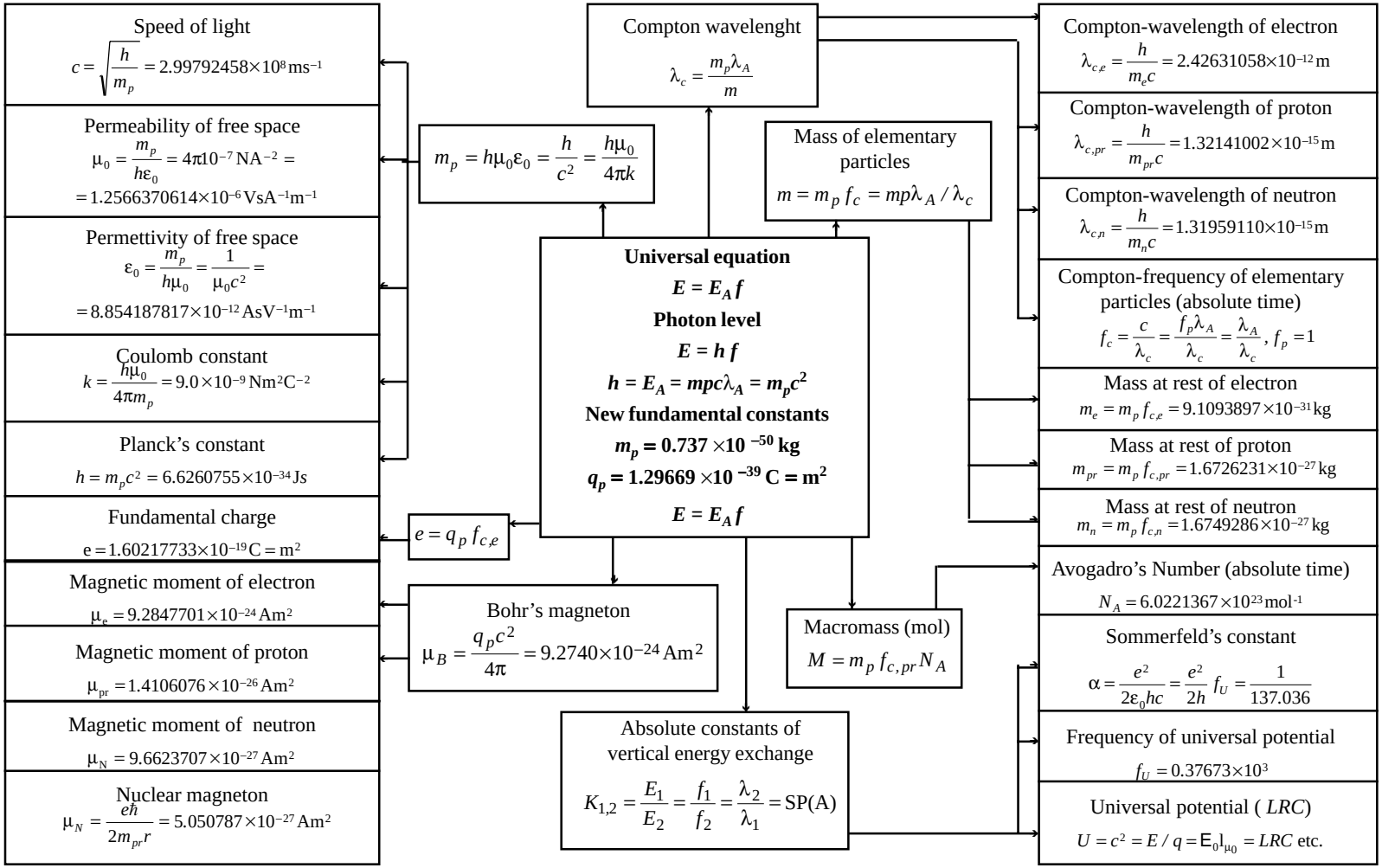

Table 1: Integration of the fundamental constants in physics with the universal equation

Physical quantities	**Conventional equations**	**Space-time-equations**
Energy/space-time E - Universal equation - Einstein's equation - Kinetic energy - Work etc.	 $E = E_A f$ $E = mc^2$ $E = 1/2mv^2$ $E = Fs$	 SP(A)[1*d-space-time*][1*d-space*] f = =SP(A)[2*d-space-time*]
Absolute time f Reciprocal time $1/t$ Frequency, f	$f = \frac{E}{E_A} = \frac{1}{t}$	f
Velocity (speed),v - Tangential velocity, v - Angular frequency, ω	 $v = s/t = p/m = etc.$ $v = 2\pi r/T = uf = etc.$ $\omega = 2\pi f = kv = 2\pi/T = etc.$	 [1*d-space-time*]
Conventional space quanities - Length = wavelength, *pi* - Area - Volume	 s, λ, $\pi = u/d$ s^2 s^3	 [1*d-space*] [2*d-space*] [3*d-space*]
Action potential, E_A Electric current, I	$E_A = \frac{E}{f} = K_s f = I = \frac{Q}{t}$	SP(A)[2*d-space*]f = = SP(A)[1*d-space-time*][1*d-space*]
Structural complexity as *area* Structural complexity as SP(A) - *Mass of basic photon*, m_p - *Charge of basic photon*, q_p	$K_s = E/t^2 = Q$, *when* $f = 1$ $K_s = E/E_R = E/c^2 = F/a = m$ $m_p = h/c^2 = h\mu_0\varepsilon_0 = etc.$ $q_p = ef = etc.$	 K_s = SP(A)[2*d-space*] K_s = SP(A)
Energy as potential = *LRC* - *Square speed of light*, c^2 - Electric potential/gradient - Gravitational potential	$LRC = E/q = E/m$ $U_U = c^2 = h/m_p = 8.987\times10^{16}$ $U_e = E/Q = q_0 \int E dl = etc.$ $U_G = E/m = gs = etc.$	 *LRC* = [2*d-space-time*]
Force, F	$F = ma = E/s = etc.$	SP(A)[1*d-space-time*] f
Momentum P, Impulse I	$p = mv = E/v = Ft = I = etc.$	SP(A)[1*d-space-time*]
Temperature, T	$T = 2K_{(ave)}/3k_b = PV/C = etc.$	f
Acceleration, g, a	g, $a = F/m = v/t = etc.$	[1*d-space-time*] f
Electric field, E - Electric field of photons, E_0	$E = F/q = U/r = grad\varphi = etc.$ $E_0 = 1/\varepsilon_0 = 0.113\times10^{12}$ ms^{-2}	[1*d-space-time*] f
Power, P	$P = dW/dt = Ef = E_A f = E_{neu}$	SP(A)[2*d-space-time*]
Angular momentum, L	$L = mvr$	SP(A)[2*d-space*] $f = E_A$
Density, ρ	$\rho = m/V = etc.$	SP(A)/[1*d-space*]
Dipole, p	$p = ql$	SP(A)[2*d-space*]
Thermal resistance, R_w	$R_w = dx/kA$	1/[2*d-space*] = $1/K_s$
Electric resistence, R_e	$R_e = U/I$	f/SP(A) = f, when SP(A)=1
Resistivity of materials, ρ	$\rho = RA/l$	[1*d-space-time*]
Electric flux, ϕ	$\phi = EA = Es = E_a v = etc.$	SP(A)[2*d-space-time*][1*d-space*]
Magnetic flux, ϕ_m	$\phi_m = BA$	SP(A)[2*d-space*]$f = E_A$
Magnetic field, B	$B = F/qv = E/E_A = etc.$	f
Magnetic moment, m_m	$m_m = (q/2m)L$	SP(A)[2*d-space*] $f = K_s$, *when* $f = 1$
Total energy density of electro-magnetic waves (= Photon density), η	$\eta = E\lvert f(x)\rvert = \lvert\psi\rvert^2 = \varepsilon_0 E^2$	SP(A)/[1*d-space*] = = f^2/[1*d-space*]

Table 2: Axiomatics of basic physical quantities as derived from the primary term of space-time

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